caudeal

UNIVERSITY OF IDAHO
AGRICULTURAL EXPERIMENT STATION

Departments of Entomology
and Plant Pathology

IMPERIAL MYCOLOGICAL
16 FEB 1939
INSTITUTE

Idaho Recommendations for Insect and Plant Disease Control

By
CLAUDE WAKELAND
and
C. W. HUNGERFORD

BULLETIN No. 159 (Revised) MAY, 1934

Published by the University of Idaho, Moscow, Idaho

The insects, plant diseases and causal organisms discussed in this bulletin are only those of economic importance which are known to occur in Idaho.

Table of Contents

	Page
Insecticides	3
Plant diseases	50
Insecticides and fungicides	68
List of insects, plant diseases and causal organisms	78
Index	81

Insects

ALFALFA LOOPER. The color of the larvae varies from cream to yellowish green and dark green. Fully grown larvae are about 1 inch long, and crawl in a looping fashion. They feed on various weeds and crop plants, including alfalfa, rarely becoming numerous enough to cause serious injury.

Control: Infestations of importance usually develop on the first crop of alfalfa a short time before the date for cutting. The most practicable means of control is to cut the first crop as soon as damage is becoming severe. Cure and remove the hay from the field as soon as possible.

ALFALFA WEEVIL. The adult is a dark brown beetle 3/16 inch long, with a moderately long snout which points downward from the under side of the head. Fully grown larvae are about ¼ inch long. The color of the larva varies from dingy yellow, when very young, to light green when mature. Larvae are readily recognized by a faint white stripe down the middle of the back and by a black head. They destroy the tips of the first crop of alfalfa or, when infestations are heavy, defoliate the plants as well as retard the growth of the second crop.

Control: When injury is severe, the first crop of alfalfa should be sprayed with calcium arsenate in water at the rate of 2 pounds per acre. The spraying should be done as soon as the tips of the plants have a generally ragged, eaten appearance. Spraying on the first crop prevents further damage to both first and second crops. When the infestation is light, cut the first crop for hay when the injury begins to be generally noticeable.

ANGOUMOIS GRAIN MOTH. The moth varies in color from buff to grayish or yellowish brown. It is about 5/16 inch long. Eggs are laid on or near grain. Larvae are white with yellowish brown heads. They are about 1/5 inch long when mature. Injury in Idaho is confined to grain in storage. Larvae hollow out the interiors of kernels and pupation takes place inside the kernels. Kernels from which moths have emerged are identified by the circular emergence holes.

Control: Follow the recommendations for saw-toothed grain beetle. Fumigation by the use of hydrocyanic acid gas is recommended for eradicating the insects in buildings. Write to the Agricultural Experiment Station for special instructions.

ANTS. Many species of ants are troublesome in houses, lawns, gardens, fruit trees, etc. Before attempting control it is necessary to locate their nests, if possible. Ants in fruit trees are usually attracted by aphids, on the sweet secretions of which they feed. They also kill or drive off the natural enemies of the aphids.

Control: When nests are located the ant colonies are often completely eradicated by making from one to three or four holes (depending on the size of the mound) in the mound, about 12 inches deep and pouring into each hole 1 ounce of granular calcium cyanide or 2 ounces of carbon disulphide and then covering the hole with earth. These materials kill vegetation and cannot be used in close proximity to growing plants. When it is desirable to kill colonies among growing plants, concentrated pyrethrum extract, diluted 1 to 1000 parts of soapy water, should be used to thoroughly wet the interior of the nests. The ordinary household pyrethrum insecticides should be diluted 1 part to 500 parts of soapy water. To make suds, use 2 to 4 tablespoonfuls of soap flakes. Scrape away the top of the nest saucer-like, and pour the liquid into the center so that it will penetrate to the bottom of the nest. Pyrethrum dust is also very effective against ants and harmless to plants. Sprinkle the dust on the ant nest and stir lightly into the surface, or sprinkle a little dust occasionally into the entrance to the nest.

Fruit trees infested with aphids should be sprayed in accordance with directions for control of these insects to prevent them from attracting ants to the trees.

In lawns or in tree rows in orchards where definite colonies cannot be located ant infestations are gradually wiped out by the persistent use of granular calcium cyanide scattered lightly over the soil during the warm part of the day when ants are active.

Household ants usually have definite nests outside the house, and when their nests can be located should be treated as already described. When nests are not found, excellent control has resulted by scattering freely in the areas frequented by the ants a mixture composed of 75 parts of sodium fluoride, 15 parts of granulated sugar and 10 parts of fresh pyrethrum dust. This mixture is relatively non-poisonous to humans and may be kept sprinkled lightly on pantry shelves, beneath bins, etc.

A poisoned bait which is frequently quite effective is prepared by boiling together until the sodium arsenate is dissolved, water 1 pint, sugar 1 pound, and sodium arsenate 125 grains, and then adding 1 tablespoonful of honey. Place the

syrup in shallow containers easily accessible to the ants. The worker ants carry this bait into the colony to feed the young ants and the queen, thereby eradicating the entire colony within a week or ten days.

APPLE APHID. A green plant louse which feeds on the water sprouts and on tender terminal leaves, curling them badly. The black, shiny eggs are laid on the bark of the smaller branches in the autumn and hatch the following spring just before the bud scales separate. There are many generations in a season.

Control: Spray with 1 pint of nicotine sulphate and 1 gallon of dormant-type oil emulsion in 99 gallons of water when the green tips of the buds are separating, or add 1 pint of 40 per cent nicotine sulphate to each 100 gallons of dormant oil emulsion or lime-sulphur spray used for San Jose scale control if the spray is applied at the time above indicated. When control is not obtained in the early spring it is practicable to add ¾ pint of 40 per cent nicotine sulphate and 1 gallon of summer-type oil emulsion to each 100 gallons of spray at the time of the first or second cover sprays for codling moth.

APPLE LEAFHOPPER. Severe injury is caused to the foliage of apple and prune by the feeding of both the young and the adult forms of two species of leafhoppers. The green colored species has but one generation each year and feeds only on apple. The white colored species has two generations and feeds on both apple and prune. Both species occur in the early spring in the nymphal stage and the injury from each is similar. Injured leaves lose their green color, become dry, and are covered with tiny, light-colored flecks. The injury results from the insect sucking the sap out of the leaf tissue.

Control: Control is the same for both species. It is not difficult to obtain good control but spraying must be done at the right time. The most effective time is when nymphs of the green leafhopper and nymphs of the first generation of the white species are present on the foliage. This is about the time of the first or second codling moth cover sprays. At that time they are readily controlled by the use of summer-type oil emulsion at the rate of 1 gallon in 100 gallons of spray solution. Attention must be directed to covering the under surfaces of the leaves. After the insects become winged, they are difficult to kill and it is necessary to add 40 per cent

nicotine sulphate or concentrated pyrethrum extract at the rate of 1 pint to 100 gallons of the oil emulsion spray. When oil is used in the first two cover sprays for codling moth control it usually controls leafhoppers on apple.

BARK BEETLES. Stout, cylindrical, brownish to blackish beetles which are 1/8 to 3/16 inch long. The larvae are grub-like, white to cream in color, and are found beneath the bark of living trees which they attack. The adults bore 1/16 inch holes in the bark. Their presence in the trees is characterized by the boring dust at the base and pitch tubes on the trunks of the trees. The green foliage of attacked trees turns first to a pale green, then to light yellow, and finally to brown, when the trees are dead. They attack mostly mature coniferous trees.

Control: No control is known which will save trees that have been attacked. Unattacked trees may be protected by felling the infested trees before the insects have reached maturity, removing and burning the bark and slash, and allowing the trunks of the trees to dry out.

BEDBUGS. Bedbugs are widely distributed in Idaho and infestations are worse in old houses that furnish protection and render control extremely difficult.

Control: The only completely satisfactory method of eradicating bedbugs quickly is by fumigation. Special precautions must be followed. Those interested should write for Idaho Extension Bulletin No. 38.

In cases where it is impracticable or not desirable to fumigate, relief is obtained and sometimes infestations even eradicated by persistent "doping." Spray liberally all cracks and crevices in walls, woodwork, bedsteads, etc., with gasoline, or kerosene-pyrethrum (made by mixing 1 part of concentrated pyrethrum-oil extract with 19 parts of kerosene). Remove all loose or torn wall paper. Wherever possible, fill up cracks in walls, floors, cupboards, etc., with crack filler or putty, and complete the work with a coat of paint, or varnish. A mixture of corrosive sublimate 1 ounce, alchohol 1 pint, and turpentine ¼ pint painted into cracks in bedsteads, walls, etc., is effective in local applications when used repeatedly.

BEET LEAFHOPPER. This sucking insect is only about 1/8 inch long when fully grown, and in the spring is pale or yellowish green in color. It feeds on sugar beets and related plants, on tomato, squash, beans, spinach, and many other

plants. It winters in the adult stage. The insect breeds on mustards, Russian thistle, and other plants in desert areas, abandoned dry farms, and waste places from whence the adults migrate to beet fields during the spring and early summer. It transmits a disease known as curly-top from one infected plant to another. The size of the population and the degree of disease vary from year to year, the variation depending, to a large extent, on climatic and native host plant conditions.

Control: No practical control methods are yet known. Beets should be planted in areas susceptible to infection only during years when it is known that over-wintering populations are low. The beet leafhopper laboratory of the Bureau of Entomology, United States Department of Agriculture, located at Twin Falls, Idaho, issues an annual forecast in February each year. Growers should plan their beet program after this forecast is available for the year, and should not plant beets in areas where the forecast indicates there is likelihood of large populations of leafhoppers. The use of curly-top resistant strains recommended by the U. S. Department of Agriculture is advisable.

BEET WEBWORM. The moth is slightly more than ½ inch in length and when at rest, with the wings folded over the body, is triangular in outline. The moth is delicate gray or brown. When disturbed it takes wing, making jerky, zigzag flights. Eggs are pearly white or yellowish, flat, about the size of a small pinhead and are laid on the under leaf surfaces in rows, often with the eggs overlapping. Larvae vary from light green to dark green and have a characteristic darker line down the middle of the back with a row of dark circles on either side. When fully grown they are about ¾ inch long. There are two generations annually. They winter in the pupal stage in the soil and the moths appear in the latter part of May or early June. Larvae are most abundant from the last of June to about the middle of July. When abundant they completely defoliate sugar beets and other related plants, as well as alfalfa and many other cultivated plants.

Control: Webworms breed on many kinds of weeds, especially lamb's-quarter and Russian thistle. These weeds should not be allowed to grow near or in fields where beets are planted. Beets should be inspected often and sprayed or dusted as soon as eggs or tiny larvae are found on the under surfaces of the leaves in June. Spray infested fields thoroughly with lead arsenate or calcium arsenate in water, at the rate of 8

pounds per acre. To the spray add a spreader at the rate of ½ pound to each 100 gallons of liquid. The spreader greatly increases the adherence of the liquid to the beet foliage. Paris green may be used at the rate of 4 pounds per acre, but it is a material of such poor physical condition that its use often results in uneven distribution and in much trouble with spray equipment. A practical means of control is to use hand dusters and apply calcium arsenate dust, diluted with 3 pounds of hydrated lime or diatomaceous earth to 1 pound of poison, at the rate of from 15 to 20 pounds of the mixture per acre. Dusting has the advantage of using cheap, simple equipment. Calcium arsenate is low in cost and hand dusters can be put into operation very quickly. Webworms are not difficult to control if the work is undertaken while the worms are small. It is imperative that control be obtained early before damage to beets occurs.

BLACK CHERRY APHID. This large, shiny, black plant louse curls terminal foliage of cherry trees and excretes a sticky honey-dew on leaves and fruit. It winters in the egg stage on the trees. Eggs hatch about the time buds burst in the spring. There are several generations annually on cherry trees.

Control: Spray with 40 per cent nicotine sulphate, ¾ pint, and dormant-type oil emulsion, 1 gallon to 99 gallons of water, just as the buds are breaking, or add the nicotine sulphate to the dormant oil or lime-sulphur sprays.

BLACK PEACH APHID. This plant louse winters on the roots and migrates to the twigs about the time buds are swelling. Adults are shiny black; young are reddish brown.

Control: Spray with 40 per cent nicotine sulphate as for "apple aphid" as soon as the insect is observed on the tips of the twigs or on foliage.

BLACK VINE WEEVIL. This snout beetle is about 5/16 inch long, and brownish black in color. The white legless larvae are about ⅜ inch long. They live in the soil and feed on the roots of strawberry and many other plants.

Control: The same control measure recommended for the strawberry root weevil is effective, but the bait should be applied just after the date when berries from annual varieties are all harvested.

BLISTER BEETLES. Three species are sometimes injurious to cultivated crops, especially near the margins of fields. The spotted blister beetle is the most common. It is from ½ to ¾ inch long, of general gray appearance with small black spots. The ash-gray blister beetle, somewhat smaller than the spotted blister beetle, is uniformly gray in color. Nuttal's blister beetle is green or purplish blue, varying from about ⅝ inch to 1 1/8 inches long. Larvae live in the ground, some of them feeding on grasshopper egg masses, and infestations usually occur in areas where grasshoppers have been numerous.

Control: Control is not often necessary but occasionally it pays to prevent injury, especially around the edges of sugar beet, alfalfa, and potato fields. Dust the infested plants and the beetles thoroughly with a mixture of equal parts of sodium fluosilicate and hydrated lime, or with undiluted calcium fluosilicate.

BOXELDER BUG. This insect is about ½ inch in length, black in color with red markings. It sucks the sap from boxelder trees. When this bug is abundant it frequently becomes a nuisance in dwellings.

Control: When bugs collect in numbers on buildings or on trees they may be killed by spraying with 40 per cent nicotine sulphate or with concentrated pyrethrum extract 1 pint to 100 gallons of soapy water. Boxelder bugs are reported to breed only on pistillate trees. Cutting out of pistillate trees and the planting of only staminate forms insures immunity from the pests.

BULB MITE. This white, eight-legged creature is only about 1/32 of an inch long. It is usually found in colonies on roots or bulbs or in decaying vegetable matter, always away from the light. It injures many kinds of bulbs and breeds continuously in greenhouses or wherever moisture and temperature are high.

Control: Plant bulbs on ground that has been kept well aerated and cultivated and free from decaying vegetable matter. Burn all soft or decayed bulbs. Store bulbs at a temperature of about 35° F. Before planting immerse all infested bulbs for 10 minutes in 40 per cent nicotine sulphate, 2½ teaspoonfuls to 1 gallon of water at a temperature of 110° F., or in a 2 per cent formalin solution for the same time and at the same temperature.

CABBAGE APHID. These dark green or bluish plant lice, covered with a powdery secretion, sometimes become exceedingly abundant on the under sides of leaves of individual cabbage plants. From these they later spread to other plants in the field.

Control: Pull and destroy individual infested plants as soon as they are observed in the spring, or dust or spray them with nicotine sulphate. When fields are generally infested, dust or spray the entire area as soon as the aphids are observed. Use 2 per cent nicotine dust prepared as described on page 75, or a spray solution composed of ¼ pint of 40 per cent nicotine sulphate and 25 gallons of water to which has first been added 1 pound of laundry soap or 1 quart of summer-type oil emulsion. Plants should be very thoroughly dusted or sprayed and kept free from the aphids until after the heads have formed well. Late season spraying is usually unsatisfactory and is unnecessary if early control is maintained.

CABBAGE MAGGOT. Adults are gray flies resembling the house fly but are smaller. The flies deposit their eggs on the soil near the stem of the plants, and the maggots hatching from them infest the stems of cabbage and cauliflower and the fleshy roots of radish and turnip. Maggots are cream colored.

Control: Dissolve 1 ounce of corrosive sublimate in 10 gallons of hot water and pour a half-cupful of the solution on the ground immediately around each plant or along the row in case of radishes. Make the first application 5 days after setting out cabbage plants and repeat two or three times at 10-day intervals.

CABBAGE WORM (IMPORTED). The cabbage butterfly is white and is frequently observed flying about cabbage fields. The yellow eggs are placed singly and on end on the under sides of cabbage leaves, nasturtium leaves, etc. The cabbage worm is light green and velvety in appearance, and when mature is about ¾ inch long.

Control: The best means of control in Idaho has been found to dust the plants heavily with Paris green 1 part mixed with flour 25 parts. A less satisfactory control is to spray with calcium arsenate, 1 pound to 25 gallons of water, in which is first dissolved 1 pound of laundry soap. Plants may also be dusted with a mixture of calcium arsenate, 1 part, and hydrated lime, 3 parts. Control should be begun as soon as lar-

vae are first noticed and continued until after the heads have begun to form well. Heavy dusting before the heads form prevents the necessity of later control when there is danger from applying poisons.

CARPENTER WORM. These pinkish or white larvae with brown heads sometimes completely kill trees. Mature larvae are about 2½ inches long. The large dark gray moths deposit their eggs in the early summer in cracks or crevices of bark or near wounds or the openings of old burrows. The young larvae, as soon as they hatch, begin boring into the trees and feed and grow inside the wood for nearly three years. Injury is especially severe in the region of the main crotch on the trunks of cork elm trees.

Control: Cutting and burning trees in the winter kills the larvae and prevents the escape of moths to infest other trees. Larvae often may be dug out of the trunk by means of a sharp chisel and the wound then disinfected. Sometimes it is practicable to clean out the burrow as well as possible, force into it a small amount of calcium cyanide-linseed oil mixture, and plug the entrance with mud or putty. The mixture is made by stirring fine granular calcium cyanide into linseed oil until the consistency of thick paint. Another method is to inject carbon disulphide into the burrows by means of a small oil can.

CARPET BEETLES. Woolen goods, carpets, fur, etc., and occasionally food materials are eaten by larvae of the carpet beetles. These larvae are dark brown and very hairy. They are about ¼ inch long when mature and very sluggish in movement. The adults are small, blackish, hard-shelled beetles.

Control: See directions for control of the larder beetle.

CENTIPEDES. These tiny centipedes feed on the tender roots of greenhouse plants and when numerous eat off the new growth as fast as it is formed. They also eat into the stems near the ground and into the roots, causing small wart-like growths and allowing the entrance of disease organisms.

Control: Control is extremely difficult. Greatest care should be exercised to prevent introduction of the creatures in soil from out of doors or to prevent bringing them in with shipments of plants. The only method yet known of freeing soil of an infestation is by sterilization with steam or heat.

CHERRY FRUIT FLY. Flies are small, brownish and are distinguished by having dark bands at intervals across their wings. They emerge from the ground in June or July and fly about in the sun for a few days before beginning to lay eggs. Eggs are inserted through the skin into the flesh of the cherries. Larvae develop to maturity inside the cherries. The maggots are white and when mature are about ¼ inch long.

Control: Allowing no cherries to remain on the trees after picking time prevents the escape of any maggots to reinfest the next year's crop, for maggots do not mature until well after the date cherries should be harvested. A poisoned bait spray kills the adults which feed on it freely during the time elapsing after emergence from the ground and before they begin to lay eggs. To make the bait, add 2 quarts of molasses or syrup and ½ pound of lead arsenate to 10 gallons of water. The proper time to use the bait first is just before Royal Ann cherries begin to show the first pink coloring. One or two later sprays may be needed at about 7-day intervals. The spray is applied at low pressure and in coarse drops to the outer foliage of the cherry trees and to the foliage of nearby trees or bushes. From 1 to 2 pints of the bait per tree is sufficient.

CHRYSANTHEMUM GALL MIDGE. The adult is a very small fly, resembling a mosquito in appearance except that its body is yellowish or orange. Eggs are laid on tender shoots and new growth. When a maggot emerges from the egg it crawls over the surface of the leaf for a time, then eats into it, causing a gall formation in which it continues to live and grow. Infestations are detected by the hard, blister-like galls on the leaves or stems.

Control: Pick and destroy infested leaves as soon as they are observed. Spray infested plants at intervals of about 10 days, using 1 teaspoonful of 40 per cent nicotine sulphate to ¾ gallon of water in which has been dissolved a piece of soap the size of a large walnut.

CICADAS. Cicadas rarely injure apple trees by laying their eggs in the small branches. In depositing the eggs, the female raises the wood beneath the bark until it extrudes in splinter-like pieces and the injury may so weaken the branches that they break off. These insects are commonly known as "locusts" and are readily identified by the shrill singing of the males on hot summer days. No control method is known.

CLOTHES MOTHS (WEBBING). The webbing clothes moth is a serious pest on substances made from animal hair, wool, or feathers and annually causes heavy loss in woolen clothing, furs, upholstered furniture, etc. The moth is very light brown and scarcely ¼ inch in length. It flits about in an erratic manner and but brief glimpses of it are obtained in the evening or at night for it avoids bright light. Moths deposit their eggs on substances which will later be used as food by the larvae. As soon as the eggs hatch the young larvae seek out protected places in the folds of woolen garments, furs, etc., or in the interior of upholstered furniture, and immediately begin to feed. Fully grown larvae are somewhat less than ¼ inch long, with bodies of creamy white color and heads of brown. Damage is caused by the larvae only.

Control: Articles subject to attack should not be left undisturbed for long periods. Clothing should be frequently brushed and aired, preferably in bright sunlight. When clothing is not in use it should be placed in a trunk or box with a tight-fitting lid with about 1 pound of naphthalene or paradichlorobenzene. If clothing is kept in moth-tight paper bags or wrapped securely in paper it should be enclosed with one of the above chemicals. These chemicals have no value in moth protection unless they are enclosed with the materials to be protected in containers with tight-fitting lids or doors. A splendid means of protection is the construction of a small moth-proof closet in the basement, in which a supply of paradichlorobenzene is kept, where garments which are not in constant use may be hung.

Individual pieces of furniture may be fumigated in small rooms or tight compartments. When entire buildings are infested all forms of the moth should be killed. Special precautions must be followed in fumigating. Persons interested should write to the Idaho Agricultural Experiment Station for specific instructions.

CLOVER APHID. Clover aphids are small green or pink plant lice that may become very abundant in clover blossoms. They secrete a sticky honey-dew that lowers the quality of the seed and they often greatly reduce the yield.

Control: Probably the best means of avoiding loss is to produce seed from the second crop. Clip the first crop when the infestation becomes heavy, remove the hay as quickly as possible and allow the field to remain without water until the plants are dry—about 10 days in good sandy loam soil. If the sun is hot and the ground dry, good control on second crop

clover is attained. The aim should be to clip the first crop as late as possible and yet be assured of maturing seed on the second crop.

CLOVER LEAF WEEVIL. The adult weevil is about ¼ inch long, light brown and has a prominent snout projecting forward from the front end of the head. Eggs are inserted in punctures in the stems in the autumn. Larvæ are green, shading to pink at the rear end, and are marked by a white line lengthwise of the middle of the back. Mature larvæ are about ½ inch long. Hibernation takes place in both larval and adult stages. There is one generation annually. Adults and larvae eat notches in the margins of leaves.

Control: Control is rarely necessary. When clover fields are heavily injured they may be clipped, and the field allowed to remain without irrigation water for a few days before the next growth starts.

CLOVER MITE. This small, brown, eight-legged creature injures leaf tissue and causes low vitality in trees. Damage is not accompanied by webbing. It may be distinguished from the two-spotted mite and the European red mite by its longer front legs, being larger and of a darker brown color. Mites pass the winter in the egg stage. Eggs are laid in the crotches of the limbs or around the bases of fruit spurs. There are many generations annually. It seldom causes severe injury in Idaho.

Control: Dormant-type oil emulsion sprays the same as for San Jose scale kill the eggs when applied while trees are entirely dormant. The same sprays or dormant strength lime-sulphur applied just as the bud scales begin to separate, destroy the newly-hatched mites. Summer control consists of the application of summer-type oil emulsion spray at the rate of 1½ gallons of the emulsion to 100 gallons of water. When oil emulsion is used in the first two cover sprays for codling moth it usually controls the brown mite.

CLOVER NEMATODE or EELWORM. These tiny, almost microscopic creatures attack red clover plants at the crown, causing a swelling at the bases of the leaves. Some of the so-called "winter killing" is induced by eelworm attack.

Control: Infested fields should be plowed up as soon as injury becomes extensive and rotated to other crops before being reseeded to red clover.

CLOVER ROOT BORER. Tiny brown beetles and small cream colored grubs that bore into the roots of red clover forming tunnels, killing plants, and opening the way for entrance of disease organisms.

Control: The clover root borer is of little importance where stands are maintained for only one seed crop year. It is advisable to rotate land to other crops after one clover seed crop has been produced in areas where this insect is troublesome.

CLOVER ROOT CURCULIO. This beetle somewhat resembles the alfalfa weevil but is smaller, blacker, and has a shorter and broader snout. It is widely distributed in Idaho, but has been of comparatively little importance, probably because of the rotation and irrigation systems followed.

CLOVER SEED CATERPILLAR. This caterpillar is about 5/16 inch long when fully grown, ranges in color from white to pinkish, and has a buff colored head. It feeds in the florets of alsike clover, destroying the floral parts and the young seed pods. It is a native insect, infesting some of the wild clovers in the higher elevations, and no control is known.

CLOVER SEED CHALCID. Damage is caused by larvae of a tiny "fly" which eats out the interiors of forming seed. Eggs are deposited inside the seeds before they reach the "dough" stage. Infested seeds have tiny holes in them, and many of them are so light that they are blown out with the chaff at threshing time.

Control: Preventive measures give partial control, and if practiced generally by all growers over a large area would hold populations of the chalcid fly down so that severe damage would rarely occur. Destroy volunteer alfalfa and clover plants near seed fields in the spring, and destroy late-seeding plants in the fall. Prevent infestation from chaff piles by feeding or burning them prior to the first of May. Thoroughly cultivate seed fields in the autumn to destroy shattered seeds by burying them to a depth of at least 2 inches. The practices outlined for the clover aphid also reduce chalcid fly injury.

CLOVER SEED MIDGE. A very delicate insect resembling a mosquito, which deposits its eggs on the flower heads. Larvae are pink in color and feed inside the individual florets causing them to "blast" before seed is formed. Loss to clover seed producers in some of the warmer areas of Idaho is very heavy during certain seasons.

Control: Pasture or closely clip the spring crop to prevent first brood larvae from becoming adults. Cut the first crop about two weeks before the larvae become mature. The procedure outlined for clover aphid offers some measure of prevention.

COCKROACHES. Two species are troublesome in Idaho. The German, or common cockroach is the smaller species, adults being about ½ inch long, light brown, and marked lengthwise on the back with dark stripes. The Oriental cockroach is about 1 inch long, very dark brown or nearly black. Both species thrive in unsanitary surroundings or under conditions where they can find protection in dark, undisturbed areas.

Control: Make conditions for their breeding and protection as unfavorable as possible. Fill cracks around baseboards, cupboards, etc. with crack filler or putty. Prevent accumulation of grease, lint, or trash in dark corners, behind cupboards, etc. Eliminate leaking pipes or drains which furnish moisture for favorable breeding. Sodium fluoride is effective if sprinkled freely in places frequented by roaches, especially in damp, dark places, under sinks, behind baseboards, etc. Repeat applications frequently and persistently until premises are rid of the pests.

CODLING MOTH. Larvae winter under bark or in soil or trash. There are from one to three generations annually in Idaho, depending on the location. Eggs are deposited on fruit or foliage.

Control: Control varies with the locality but in all localities populations are greatly reduced by sanitary precautions such as destroying all wormy apples at thinning time, destroying windfalls before worms in them have an opportunity to escape, destroying culls to prevent the escape of worms; eliminating old trees and abandoned orchards; scraping off loose bark and banding the trees with chemically treated bands, etc. Directions for preparing chemically treated bands will be found on page 69.

The only direct means of control of the codling moth is by spraying. The spray procedure varies so greatly in different localities that no statewide recommendation is possible. The calyx spray should be applied in all localities, using lead arsenate at the rate of 2 pounds per 100 gallons of water, making the application as soon as 90 per cent of the petals have fallen and before the calyx lobes have closed. The first cover

spray on the first brood likewise is the same in all localities and should be completed within from 10 to 12 days after the first codling moths are found in the bait traps. (For preparation and use of bait traps see page 68). The second cover spray should be completed within 10 to 14 days after the first. Oil, if used in the first and second cover sprays at the rate of 1 gallon of summer-type oil emulsion to 100 gallons of spray solution, increases the degree of control by killing the eggs at the time they are the most numerous in the orchard. In some seasons and some localities it is necessary to apply a third cover spray for the first brood. This should be timed from 8 to 10 days after the second cover spray, depending on moth activity. The first cover spray for second-brood larvae should be completed within eight days after the moth traps show a marked increase in the number of moths captured after July 1. The second cover spray for the second brood, when needed, should be completed in from 10 to 15 days after the first second-brood spray.

Oil sprays should not be applied after the first of July because they render residue removal difficult. Lead arsenate is recommended for control as long as it can be removed to meet the federal tolerance regulations. If tolerance is lowered to the point where it cannot be met in the use of lead arsenate, then other insecticides will have to be substituted, but the spray program will remain essentially the same as regards dates and methods of sprays.

COLORADO POTATO BEETLE. Adults are plump, about ⅜ inch long, and are marked lengthwise on each wing cover by five black and five yellow lines. They hibernate in the soil during the winter. There are two generations annually, but only the first generation appears to be of economic importance in Idaho. Eggs are yellow or orange and are deposited in clusters on the under sides of leaves. Larvae are brick-red with black spots on the back and have a "humped-back" appearance. They are about ½ inch long. Larvae and beetles feed on potato and related plants, often completely defoliating vines.

Control: Dust infested vines with a mixture composed of 1 part of calcium arsenate to 3 parts of hydrated lime, or spray them with calcium arsenate or with lead arsenate at the rate of 4 pounds to 100 gallons of water. Make applications soon after the larvae hatch and begin to feed in the spring and before they have caused appreciable injury.

CORN EAR WORM. A large dusky colored moth deposits eggs on the silks and larvae hatching from them eat into the ears. Larvae vary from yellowish green to dark green, and when mature are about 1½ inches long.

Control: Control of the corn ear worm is difficult and unsatisfactory. Keeping the silks heavily dusted with extra light, pure sodium fluosilicate gives a measure of control but is not practicable excepting in small gardens or seed plots. Apply the dust as soon as the silks appear and make frequent applications thereafter.

COTTONY MAPLE SCALE. This brown, oval, soft scale is found in the winter on the bark of maples and many other kinds of trees and bushes. In June the insects become covered with large masses of a white cotton-like substance beneath which the eggs are found.

Control: Spray with dormant-type oil emulsion at the rate of 8 gallons to 92 gallons water in the winter or just before the buds burst in the spring. A practical means of control on Virginia creeper and other ornamentals is to spray the vines with summer-type oil emulsion, 1 part to 99 parts of water, when the young scale insects are unprotected, shortly after they hatch from the eggs. This is usually the last of June or the early part of July.

CURRANT APHID. This plant louse, varying from yellowish to pinkish and dark green, winters in the egg stage on the twigs of the new growth. Eggs are glossy black. They hatch soon after the first leaves unfold. The aphids cluster on the tips, curling the leaves and causing them to turn red and drop.

Control: Spray as soon as aphids are noticed in the spring and before the leaves curl. Use 40 per cent nicotine sulphate, 1 teaspoonful to ¾ gallon of water in which has been dissolved a piece of soap the size of a large walnut.

CURRANT WORM (IMPORTED). The adult sawflies emerge when the currant leaves first unfold and lay white, elongate eggs end to end in rows along the veins on the under sides of the leaves. Larvae are muddy green with black spots excepting in the last stage when they are uniformly light green. There are two generations annually. Larvae of the first generation do most of the injury. They pupate beneath leaves and trash.

Control: Spray the bushes thoroughly with calcium arsenate 2 pounds to 100 gallons of water when fruit is beginning to set. If spraying must be done after fruit is formed, use pyrethrum extract at the rate of 1 part to 400 parts of soapy water. A second spray of lead arsenate after the fruit is picked prevents late defoliation and reduces the infestation for the succeeding year.

CUTWORMS. Smooth, shiny, gray to black worms that rest in a curled position in the daytime just below the surface of the ground. They feed mostly at night and cut the plants off at the surface of the ground. Some species, as the western army cutworm, migrate over the surface of the soil at night. Others climb plants at night to feed on foliage, such as on grape and prune. Adults are dusky brown or gray moths that fly at night and are the ones most commonly observed around lights in the summer time.

Control: Scatter poisoned bran bait (directions for preparation are on page 74) around plants to be protected or sow it broadcast over the field. In the case of sugar beets or other crops planted adjacent to weedy areas, the field margins may be protected from cutworm attack by scattering the poison bait over the surface of the ground in the area to be protected just after planting time and before the young plants appear above the surface of the ground. Where cutworms are holding back the growth of alfalfa and irrigation water is available, control usually is obtained by flooding the field heavily. Poisoned bran mash is effective in alfalfa fields which cannot be heavily irrigated.

DIAMOND-BACK MOTH. The adult of this insect is a small, light gray moth. The tiny, green, tapering larvae riddle the leaves and spin light webs about themselves on the upper surfaces of the leaves. This species is only occasionally of sufficient importance to necessitate control.

Control: Follow the instructions given under "cabbage worm."

ELM LEAF BEETLE. The beetles are about ¼ inch long, yellow or orange, are marked on the back by a black stripe down the center, a black stripe along each edge, and two elongated black spots. Eggs are orange and are laid in irregular rows on the under sides of the leaves. The larvae are dark with yellow stripes and prominent body tubercles, and are about ½ inch long when fully grown. Beetles eat holes

in the leaves and the larvae destroy the leaf tissue on the under sides. Injured leaves turn brown and trees often are completely defoliated. There are from 2 to 3 generations annually.

Control: Spray the trees thoroughly with lead arsenate, 4 pounds to 100 gallons of water, or dust them with calcium arsenate. Make applications as soon as the first larvae are found and direct the poison upward to cover the lower surfaces of the leaves. Control against the later generations is often unnecessary if it is properly carried on against the first generation.

EUROPEAN EARWIG. The mature earwig is about ⅝ inch long. The color is dark reddish brown excepting the legs, antennae, and wing-covers which are yellowish brown. The insect is readily distinguished by the presence of a so-called pair of forceps on the rear end of the body. Earwigs feed on many kinds of plants, and even enter houses, where they are obnoxious pests. They are active at night and hide in dark places during daytime.

Control: The insects feed readily on a poisoned bait made by mixing together 12 pounds of bran and 1 pound of sodium fluosilicate and then mixing in thoroughly 1 quart of fish oil. Scatter the bait thinly over the entire yard, but give special attention to baiting along board fences and about trees, telephone poles, wood piles, and other places affording hiding places. Do not sprinkle the lawn until after the bait has been out at least two nights. If sodium fluosilicate cannot be obtained, substitute sodium fluoride, barium fluosilicate or Paris green.

EUROPEAN ELM SCALE. These reddish brown, plump-bodied sucking insects are fringed with white and are covered with a "mealy" secretion. They occur most abundantly in crevices of bark and on the under sides of limbs. Heavy infestations cause the death of elms.

Control: Very satisfactory control is obtained by spraying the trees with dormant-type oil emulsion, at the rate of 8 gallons to 92 gallons of water, just before the buds burst in the spring.

EUROPEAN RED MITE. The orchardist may readily identify this species by the bright red, overwintering eggs that it deposits on the bark. Often eggs are so numerous as to give

bark areas a reddish appearance. The mites may be distinguished from those of the common red spider by the fact that they do not spin webs, and from the clover mite by being much smaller and lacking the conspicuously long front legs. Overwintering eggs hatch in the spring just before the blossoms open on apple trees. Although egg deposition frequently is extremely heavy in Idaho, severe injury from this species is rare.

Control: Control of the European red mite in the dormant season is the same as for the clover mite, and during the growing season is the same as for the common red spider.

EYE-SPOTTED BUD MOTH. The chocolate-brown larvae are about 1/3 inch long when mature. Larvae hibernate in small cocoons on the bark and in the spring eat the leaf and blossom buds, especially of prune, and frequently tie buds together with silk. Moths appear in mid-summer and deposit their eggs singly or in clusters on the under surfaces of the leaves. There is one generation annually.

Control: Spray with lead arsenate, 3 pounds to 100 gallons of water, just as leaves are showing green in the spring. Pay special attention to the tips of branches.

FALL WEBWORM. Fall webworms attack many kinds of fruit trees and native shrubs. Their presence is detected by loosely-woven, dirty white webs which enclose the foliage on the ends of the branches. Webs enclose many pale yellow, black spotted, very hairy caterpillars which feed upon the surface of the leaves. Webs are very unsightly due to the presence of the black pellets of excrement of the larvae.

Control: Webs are readily removed by clipping off the terminal twigs which are enclosed in them and burning them. They may be burned out of the trees by the use of a kerosene-saturated burlap sack fastened to the end of a long pole. Spraying with lead arsenate or dusting with calcium arsenate controls them where infestations are extensive.

FALSE CHINCH BUG. Small brown to black, flat bodied bugs that suck sap from the leaves. When numerous, they cause leaves to wilt, turn brown and become crisp. They usually attack cultivated crops only in weedy areas or after weeds in adjacent fields dry up following drought periods in the summer.

Control: Destroy weeds and do not plant crops susceptible to injury near waste or weedy areas. Plow under weeds the fall before fields are to be planted and destroy weeds in the early spring to prevent breeding of bugs which later migrate to cultivated crops. When hordes are migrating they may be checked by plowing a furrow, keeping the bottom dry and dragging a log in the furrow to kill the bugs and to keep the soil in a dusty, loose condition.

FALSE WIREWORMS. These are yellow, shiny worms measuring about 1 inch in length at maturity. They destroy planted kernels and sprouts of dry-farmed wheat both in the early spring and the late fall. Adults are large black beetles readily recognized by their habit of "standing on their head" when disturbed. Adults feed on wheat, various grasses, and weeds. Adults emerge in August, winter in protected places, and deposit their eggs in the soil the following spring. Larvae hatch in May and continue to feed and grow in the soil until mid-summer of the following year, when they pupate. It requires two years, therefore, to complete the life cycle. A smaller species also occurs in dry-farmed areas and predominates in certain localities. Its life cycle is quite similar and it responds to the same control measures as those for the larger species.

Control: Beetles eat poisoned bran bait freely and are cheaply controlled by its use. (See page 74 for preparation. Paris green is somewhat more effective than white arsenic). Scatter the bait along fence rows, road sides, among rocks, and in waste places where beetles congregate. Make applications about September 15 on two successive years.

FIRE BRAT. This insect lives in warm, moist places in dwellings and sometimes causes damage by eating paper products, book bindings, etc. Adults attain a length of about ½ inch and are recognized by two very long antennae and three long appendages on the rear of the body. They move very quickly.

Control: Clean out breeding areas, destroy debris, etc., which furnish protection and food. A poisoned bait, composed of 1 pound of finely ground or cut oatmeal, 1 ounce of white arsenic, ½ ounce of granulated sugar and ¼ ounce of salt, is quite effective in control. Mix together the oatmeal, white arsenic, sugar, and salt. Moisten the mixture with water to thoroughly bind the substances together. Then dry the bait thoroughly to prevent mold and crush it up into

small bits. Scatter the bait lightly behind bookcases, radiators, on shelves, etc., and in other places frequented by the insects. It is effective over long periods of time without renewal.

FOREST TENT CATERPILLAR. These caterpillars collect in dense masses on branches of trees. They are dusky brown with a fine yellowish brown stripe down the back and on each side. They may attain a length of about 2 inches when mature. They often strip the foliage from native trees and from fruit trees. Their eggs are deposited in a complete ring around the smaller twigs and are closely cemented together. There is one generation annually.

Control: Spray with lead arsenate, 3 pounds to 100 gallons of water, or dust with calcium arsenate.

FOUR-SPOTTED TREE CRICKET. This cricket closely resembles the snowy tree cricket but is found more generally on plants with pithy stems, such as raspberries or grapes. Eggs are deposited through the bark and into the central pith and are laid in series. The life history is similar to that of the snowy tree cricket.

Control: Prune out, in the spring, canes containing eggs. In severe infestations in berry patches, spray the plants heavily with lead arsenate, 2 pounds to 100 gallons of water, as soon as the berry crop is harvested. This reduces the infestation the following year.

FRUIT TREE LEAF ROLLER. Moths are a little less than ½ inch long, fawn colored or rusty brown, and have a prominent light spot on the outer margins of the wings. They appear in mid-summer and lay their eggs in irregular flat masses on the bark. Eggs are entirely covered with a grayish cement-like substance. Larvae hatch about the time the buds begin to open and are quite active, crawling backward about as well as forward and often may be observed hanging from the tree by a thread. The caterpillars roll the leaves, eating ragged irregular holes in them and in extreme cases completely defoliate the trees.

Control: Spray the trees thoroughly with dormant-type oil emulsion to kill the eggs before they hatch. Spraying should be done before the buds begin to burst. In severe cases use the emulsion at the rate of 8 gallons to 92 gallons of water. One half of that dosage is sufficient in cases of light infes-

tations or where orchards are being regularly sprayed with oil for San Jose scale control.

GARDEN SLUG. Slimy, shiny, dark green or gray creatures resembling snails. They injure strawberries where they come in contact with the ground.

Control: Keep soil moderately moist and well aerated. Scatter poisoned bran bait (page 74) and spray the plants with 6-6-50 Bordeaux mixture (page 69).

GOOSEBERRY FRUIT WORM. The larva is about ¾ inch long when mature and has a black head. Larvae eat into gooseberries in the spring. Infested berries usually color prematurely and dry up on the bushes or fall to the ground. Larvae make their way into the ground where they pupate and pass the winter in this stage.

Control: There is no direct means of control known. Populations are greatly reduced and injury prevented by carefully removing and burning all leaves and trash beneath the bushes in the fall and by keeping the ground beneath the bushes thoroughly cultivated to destroy overwintering pupae.

GRANARY WEEVIL. This mahogany-brown beetle is slightly more than 1/8 inch long, and has a head that is prolonged into a slender snout. The beetles feed upon grain and grain products and the grubs live inside of the kernels of grain. In the household the same precautionary measures recommended for the saw-toothed grain beetle are satisfactory for this insect. Storage bins should be cleaned before new grain is placed in them. Small quantities of infested grain may be fumigated by the use of 1 ounce of carbon disulphide to every 100 pounds of seed closely enclosed in a tight container. Pour the carbon disulphide into a shallow receptical on top of the grain, close the container and allow it to remain closed for 48 hours. The vapor is very inflammable and must not be handled near a flame of any kind.

GRAPE LEAFHOPPER. This sucking insect is only about 1/8 inch long when mature and varies in color from yellowish green to red. Adults fly but nymphs are wingless. Adults hibernate and then make their way to grape leaves about June 1. They deposit their eggs on the under surfaces of the leaves. The young leafhoppers hatching from these eggs feed on the under surfaces of the leaves until they reach the adult stage, sometime in July. A second generation develops in the

late summer. Injury is caused by both adults and young. A discolored area develops around each feeding puncture and when leafhoppers are abundant the entire leaf may become discolored and have a scorched appearance.

Control: Overwintering adults are rarely numerous enough in Idaho to cause injury and they are very difficult to kill. It is best to watch for the appearance of the young on the under surfaces of the leaves in June and when the first of these begin to reach the adult stage to spray the vines thoroughly with 40 per cent nicotine sulphate ¾ pint, summer-type oil emulsion 1 gallon, and water 99 gallons. Use high pressure and direct the stream upward so that the under surfaces of the leaves are heavily covered.

GRASSHOPPERS. Grasshoppers eat the foliage, blossoms, seeds, and fruits of many crops. Several species are of economic importance in the state, all having similar life habits and responding to the same control methods. Eggs are laid in the ground in pods containing from about 15 to 100 eggs each. The pods are inserted in the soil at depths varying from very shallow to about three inches. Eggs are laid most abundantly in firm ground or sod along ditches, roadsides, fence rows, and waste places. Eggs are surrounded by a protective secretion and in their position in the ground are not greatly influenced by climatic conditions. Young 'hoppers hatch in the spring as soon as the soil surface becomes warm.

Control: The most dependable and economical method of control is to scatter poisoned bran bait prepared as described on page 74. It should be scattered at the rate of 10 pounds per acre in the morning as early as the 'hoppers become active. The greatest returns from the bait are obtained when 'hoppers are small and before they have begun to migrate, but it may be used successfully to protect crops at any time during the growing season. In alfalfa and clover seed fields and in grain crops, gardens, etc., it is necessary to scatter it generally throughout the field. When grasshoppers attack alfalfa hay crops it is usually just before the first crop is cut. In such cases a strip of alfalfa should be left uncut in the center of the land and heavily treated with bait to kill the 'hoppers concentrated there to prevent them from attacking the tender plants of the second crop.

Spring-toothing of infested fields late in the fall destroys many eggs by exposure. Thorough and frequent discing where practicable, or plowing late in the fall, destroys many eggs.

In gardens and around ornamentals, bush fruits, etc., the poisoned bait is quite effective, but at times 'hoppers will stay on the plants destroying flower buds and foliage. In such cases they are repelled and prevented from doing damage by thoroughly spraying the plants with lead arsenate at the rate of 4 pounds to 100 gallons of water.

GREENHOUSE LEAF TIER. This insect is named from its habit of spinning light webs inclosing leaves in the web. It causes injury by destroying the under surfaces of the leaves. The larva is light green marked by lengthwise light stripes. It is very active, moving either backward or forward and often lowers itself on a silken thread.

Control: Suspend shallow pans 5 or 6 inches beneath clear glass incandescent lamps above the green house benches. In the pans keep a supply of water and kerosene. Moths are attracted to the lights and captured in the traps beneath. Lamps should be turned on within an hour after sundown and allowed to burn for two or three hours. For control of the larvae, infested plants should be sprayed with lead arsenate at the rate of 1 pound to 25 gallons of water, or dusted with a mixture of fine dusting sulphur, 6 parts, and lead arsenate, 1 part.

GREENHOUSE THRIPS. These small, narrow-bodied insects vary in color from yellow to brown or almost black. They injure both leaves and blossoms of many greenhouse plants. They have mouth parts fitted for piercing and scraping the leaf surface and for sucking the exuding sap. Injured leaves or petals become covered with whitish or silvery blotches which later run together causing dead areas. There are many generations annually and infestations breed up so rapidly that injury develops suddenly.

Control: Spray with 40 per cent nicotine sulphate, 1 teaspoonful in ¾ gallon of water, in which has first been dissolved a piece of soap the size of a large walnut; or dust with nicotine dust containing 2.4 per cent actual nicotine (see page 75 for preparation of nicotine dust). Direct the applications at the under sides of the leaves and repeat at weekly intervals as long as needed.

GREENHOUSE WHITEFLY. The tiny, four-winged, white, powdery adults are about 1/16 inch long. They are readily observed while resting on the under sides of the leaves. If numerous they rise in small white clouds when disturbed.

The young are less than 1/25 inch long. They are oval, flat, scale-like, and pale green in color. Fine waxy threads of various lengths radiate from the body. Adults and young both feed on the leaves, sucking the juices. Injured plants turn yellow, wilt, and may die.

Control: Whiteflies are probably best controlled by repeated fumigations with calcium cyanide used at the rate of ½ ounce per 1000 cubic feet of space. Fumigations should be spaced about two weeks apart until the infestation is eradicated. In using calcium cyanide follow the directions of the manufacturers.

GREEN PEACH APHID. This green plant louse injures new growth and curls terminal foliage. It winters in the egg stage. Eggs are black and shiny and are deposited in crevices in the bark and around the bases of buds. Eggs hatch just before the buds open in the spring.

Control: Dormant-type oil emulsion applied just before the buds open is fairly effective in control. If the dormant spray is lime-sulphur it should be delayed until just before the buds open and ¾ pint of 40 per cent nicotine sulphate added to each 100 gallons of dilute spray. For foliage sprays use ¾ pint of 40 per cent nicotine sulphate and ½ gallon summer-type oil emulsion to 100 gallons of water.

(HOLLYHOCK) APHID. Dark reddish plant lice that cluster on buds and leaves causing them to wilt and wither and often preventing blossoming.

Control: Spray with 40 per cent nicotine sulphate, 1 teaspoonful to ¾ gallon of water in which is dissolved a piece of soap the size of a large walnut. Make application as soon as first aphids are observed and repeat if necessary.

HOLLYHOCK BEETLE. This oval shaped beetle is about 3/8 inch long. The head and thorax are black, wing covers are yellowish to orange with irregularly-shaped black lines extending lengthwise. Beetles severely eat the leaves of hollyhocks, especially those near the soil. They may be found underneath leaves or trash beneath injured plants.

Control: Spray the leaves with lead arsenate or calcium arsenate at the rate of 1 pound to 25 gallons of water.

HOP LOOPER. The grayish-brown moth is between ½ and ¾ inch long. The mouth parts project forward from the

head resembling a snout. Caterpillars are pale green, about 5/8 inch long when mature. They feed on the leaves of ornamental hops, causing ragged, unsightly appearance.

Control: Dust the vines with pure calcium arsenate or lead arsenate, or spray with lead arsenate, 3 pounds to 100 gallons of water. Apply when the first holes are observed in the leaves and repeat two or three weeks later if necessary.

HOUSE FLY. This loathsome insect breeds in all kinds of filth, garbage, human excrement, manure, etc. It is a filth and disease carrier. Its presence is indicative of filth some place nearby. "No filth, no flies."

Control: Burn, bury, or dispose of garbage immediately. Keep garbage cans covered. Protect foods by screening. Keep stables clean. Haul manure away at least once a week and spread it where it is exposed to sunshine. Fly populations around barns, homes, stores, etc., can be greatly reduced by the use of traps, a number of which are on the market. Proprietary poisons and sticky fly preparations that greatly aid in reducing the numbers of flies are also on the market. A good fly poison may be made cheaply by mixing together 1 tablespoonful of 40 per cent formalin, 1/4 pint of sweet milk or buttermilk, and 1/4 pint of water. Expose this mixture to the flies in shallow dishes. Many proprietary sprays on the market will stupefy flies after which they may be swept up and burned.

LACEBUGS. Small, flat, sucking insects that feed on the lower surfaces of leaves of many plants. The head and body frequently are completely hidden by the lace-like covering of the thorax and the wings. This lace-like covering is often nearly transparent, showing many veins. Adults are only about 1/8 inch long. The young are darker in color, often covered with spines, and do not resemble the adults. Injured leaves show light flecked areas and quantities of dark pellets of excrement.

Control: Spray with 40 per cent nicotine sulphate or with concentrated pyrethrum extract at the rate of 2 teaspoonfuls to 1 gallon of soapy water. Direct the spray so that it will hit the insects in flight and so it also will cover the lower surfaces of the leaves.

LARDER BEETLE. The brown, hairy larva of the larder beetle is occasionally found in woolen fabrics and in food ma-

terials. It is very sluggish of movement. The beetle is about ¼ inch long, black in color, with a wide, pale yellow band running cross-wise on the wing covers.

Control: Houses severely infested should be fumigated (send to the Agricultural Experiment Station for special instructions). Moderate infestations should be cleaned out as directed for the saw-toothed grain beetle.

LEAF-CURL PLUM APHID. The first forms of this plant louse which appear in the spring are deep red or brownish red with brown bands cross-wise on the back. The young from these are uniformly pale green. Overwintering eggs on the bark hatch in the spring before the fruit buds of prune show signs of swelling. When leaves appear they are severely curled from the effects of the feeding of this aphid. Several generations develop on peach, prune, or plum trees before leaving for other plants.

Control: Add ¾ pint of 40 per cent nicotine sulphate to each 100 gallons of dormant lime-sulphur or oil emulsion sprays and make the application just before the blossom buds open in the spring.

LEAF CUTTER BEES. These wild bees cut large, circular holes in the margins of the leaves of rose, Virginia creeper, lilac, etc., causing an unsightly, ragged appearance.

Control: Spray the bushes with Bordeaux mixture 6-6-50 (see page 69 for preparation) or with lime-sulphur, 1 part to 40 parts of water, to repel the bees. Make the first application when damage is first observed and repeat if necessary later in the season.

LEATHERJACKETS. These tough, slate colored, tapering larvae may usually be identified by the scalloped "hood" at the rear end of the body. They are the larvae of craneflies, insects that resemble huge mosquitoes. They sometimes feed on strawberries and root crops near the surface of the ground and rest shallowly in the soil in protected places, beneath trash, etc.

Control: Cultivate the soil thoroughly near the plants and eliminate debris. Examine under leaves, hand-pick and destroy larvae. Scatter poisoned bran mash (directions for preparation, page 74) over the surface of the ground and closely around plants.

LEGUME BUGS (Previously called tarnished plant bug.) Two species occur in Idaho. These sucking insects cause puncturing of beans, blossom drop in alfalfa, decreased yield of alfalfa hay and seed, as well as injury to many other plants. Adults are about ¼ inch long, of general flat triangular shape and are quite active. The "legume bug" is yellowish green and between the wings on the back has a small triangular area with a yellowish green v-shaped mark. The "pale legume bug" is much lighter colored than the legume bug and the v-shaped mark on the triangular area between the wings is brilliant green. These bugs breed freely on legume plants, especially alfalfa, and fly to bean fields when such crops are cut.

Control: No satisfactory means of controlling legume bugs is yet known. In the case of beans it seems possible to reduce the injury by delaying the cutting date of second-crop alfalfa in adjacent fields for a week or 10 days. Clean cultivation of areas to be planted, the disposal of crop residues, and destruction of weed patches where the insects spend the winter, aid in reducing infestations.

MEALYBUGS. These small, sluggish, white, soft-bodied insects cluster on the under sides of leaves or in leaf axils. They vary in size up to about ¼ inch long. They suck the juices from the stems and leaves, discoloring and deforming the foliage.

Control: Control is extremely difficult, for insecticides used strong enough to insure kills of the insects often injure tender greenhouse plants. Probably the most practicable control is to spray with nicotine sulphate at the rate of 1 teaspoonful to ¾ gallon of water, adding 2 teaspoonfuls of summer-type oil emulsion. Spraying should begin before infestations build up to any extent and applications repeated until control is established.

MEALY PLUM APHID. This bluish-green plant louse covered with a white, powder-like secretion, becomes exceedingly abundant on the under surface of the leaves early in the spring. It is accompanied by heavy honey-dew causing a sticky secretion that drops on the upper surfaces of the leaves.

Control: Spray thoroughly with 1 gallon of summer-type oil emulsion in 99 gallons of water and add ¾ pint of 40 per cent nicotine sulphate. Use pressure and material sufficient to wet through the "mealy" covering and make application as soon as infestations are observed in the spring.

MEDITERRANEAN FLOUR MOTH. Larvae of the Mediterranean flour moth are nearly ¾ inch long when mature, are whitish, and have dark heads. They spin silken threads and form tunnels in the flour or other cereal products. Adults are dark gray moths that may be found in flour mills or dwellings throughout the year.

Control: Follow the recommendations for saw-toothed grain beetle.

MINEOLA MOTH. Fully grown larvae are slightly more than ½ inch long. They are a red-brown color, being uniformly darker from the middle of the side of the body upward than from the middle of the side downward. Legs are black and the head light brown. Partially grown larvae winter in heavy webs on the bark, become active about the time prune blossoms begin to swell, and enter the blossom buds. Larvae pupate in the soil. Moths deposit their eggs singly on the under surfaces of the leaves. Part of the insects have but one generation annually. Others pass through a second generation while some of them have three generations annually. Newly hatched larvae enter the fruits. Larvae feed only on flower buds or in the fruit, never on leaves.

Control: There is some evidence that where lime-sulphur is used annually as the dormant San Jose scale spray, infestations of Mineola are light. The best means of direct control yet found is to spray with dormant-type oil emulsion 4 gallons, water 96 gallons, and 2 2/3 pints of concentrated pyrethrum (oil extract containing 2.15 grams pyrethrins per 100 cc.) Mix oil emulsion and water as for oil spray and then add pyrethrum extract. In home-made emulsions, or with the tank-mix, first combine the pyrethrum extract with the oil and then emulsify. Make applications when the prune buds are swelling and show green at the tips and just before beginning to show white.

MORMON CRICKET. Adults are dark brown to black and from 1¼ to 1½ inches long. They are wingless. Nymphs are from about 3/16 inch to 1 inch long. They are variously colored in shades of green, red, brown, and black. Eggs are about the size and shape of grains of rye and are gray or bluish in color. They are deposited singly and shallowly in the soil or in bunches of grass, usually away from cultivated areas. Eggs are laid between June 15 and September 1 and begin hatching about April 1. Nymphs are closely banded together just after hatching and a band that later in the

season may cover several acres is then confined to a relatively small area. As the nymphs grow, they begin moving, migrating bands often being of large size and frequently reaching cultivated fields. Mormon crickets are general feeders, but their food preference is distinctly for some of the native plants, and they do not often cause serious damage to cultivated crops.

Control: The best means of control is to apply a mixture of sodium arsenite, 1 part, and hydrated lime, 4 parts; or calcium arsenite, 1 part, and hydrated lime, 3 parts; to the bodies of the crickets. Application is made by the use of hand dust guns. The insects clean the poison from their feet and antennae with their mouth parts, thus obtaining sufficient to cause death. Dusting should be done as early as possible while the tiny young crickets are bunched, for then the area to be treated is much smaller than it will be later and less poison is required to kill the insects. Migrating bands are effectively killed at any time in the year by dusting them when they can be found bunched. Dusting the vanguard of a migrating band kills large numbers of them and often has the effect of turning their direction of march.

MOURNING CLOAK BUTTERFLY. The large, spiny caterpillars are black, marked with white and red dots. They occur in groups and defoliate individual branches on cork elm, poplar trees, etc. They are rarely of much importance.

Control: Clip off and destroy infested branches, or if the infestation is severe, spray with lead arsenate, 3 pounds to 100 gallons of water, when the caterpillars make their appearance.

NEMATODES or EELWORMS (Greenhouse). These nearly microscopic creatures burrow directly into the roots of plants from soil which is infested. The irritation which they cause results in the formation of galls, swollen or knotted roots. Affected plants wilt or die.

Control: There is no known method of saving plants that have already been injured by eelworms. Ground beds may be sterilized by steam and raised benches should be emptied, cleaned thoroughly, and filled with new soil. Hot lime should be applied to the empty benches and allowed to dry for a few days before filling. Extreme care must be taken when refilling benches to procure soil free from eelworms.

ONION MAGGOT. The small,grayish fly deposits her eggs on the onion plant. Larvae are small, footless maggots, nearly white in color, and when full-grown are about ⅜ inch long. Maggots eat into the bulbs, causing them to die. Pupation takes place in the soil and winter is normally passed in the pupal stage. Maggots are able to survive the winter in onion bulbs left in the fields or in cull piles. There are two generations annually.

Control: All bulbs, cull onions, etc. in the field should be destroyed after harvest. Probably the best method of control is to spray the onions with bordeaux-oil emulsion, using 1½ gallons of emulsion to 50 gallons of spray. The emulsion is prepared by boiling together 1 gallon of light grade lubricating oil with 2 pounds of fishoil soap and 1 quart of water. After the mixture has boiled for about two minutes, pump it through a spray pump twice while it is still hot. Commercial dormant-type emulsion may be used in place of the home-prepared emulsion. Use the emulsion at the rate of 1 gallon per 50 gallons of 4-5-50 bordeaux mixture, adding it to the spray tank while filling and while the agitator is running. Apply the mixture to the row so that the soil immediately around the plants is moistened, using only sufficient pressure to break the liquid into a coarse spray. From 100 to 150 gallons per acre is sufficient. Application should be made as soon as plants appear above the ground, and should be repeated two or three times at intervals of one week.

ONION THRIPS. Tiny, yellow or brown insects that hide in "crotches" of the plants and in the soil in the daytime and feed on the plants at night or in cloudy weather. Injured leaves assume a silvery appearance and become crisp and dry.

Control: Dust the plants heavily with 3 per cent nicotine dust (see page 75 for preparation), or drench with 40 per cent nicotine sulphate, ¾ pint to 100 gallons of water, in which is first dissolved 6 pounds of potash fishoil soap; or with nicotine sulphate, ¾ pint added to a solution of 99 gallons of water, and 1 gallon of summer-type oil emulsion. In spraying, use a rod or gun and cover every plant until the liquid runs into the crotches. Start applications as soon as the first thrips are observed on the plants (about June 1), and repeat applications at 10-day intervals until the injury is past. Keeping the plants heavily dusted with hydrated lime or diatomaceous earth gives a relatively high degree of control.

OYSTER-SHELL SCALE. These are tiny sucking insects that become fixed on the bark of fruit, and as they grow cover themselves with a brown secretion resembling an oystershell in shape. There is only one generation each year. Eggs are deposited under the shell and hatch shortly after the apple trees bloom. The young insects soon fix themselves on the bark where they feed by sucking the sap. They appear as tiny yellow specks on the bark before they are covered with their secretion.

Control: Dormant-type oil emulsions used at the rate of 5 gallons to 95 gallons of water are preferable when infestations are severe. In lighter infestations lime-sulphur at the strength used for San Jose scale gives commercial control when used annually. The young may be killed by the application of summer-type oil emulsion used at the strength of 1½ gallons to 98½ gallons of water shortly after they hatch.

PEA APHID. Green plant lice occasionally become very numerous on first-crop alfalfa and frequently on sweet peas and garden and field peas. They cause injury by sucking the sap from growing plants causing foliage and blossoms to wilt and shrivel. Severely injured plants turn yellow and dry up.

Control: For sweet peas and peas planted in rows, the best control known is to dust the plants heavily with nicotine dust, made by mixing together first 8 pounds of monohydrated copper sulphate and 38 pounds of hydrated lime, and then adding 4 pounds of 40 per cent nicotine sulphate and mixing again. All the mixing must be thoroughly done. Directions for mixing are given on page 75. Dusting must be done on a calm day when the temperature is 70° F. or higher. Spraying with 40 per cent nicotine sulphate at the rate of 1 pint, and summer-type oil emulsion 1 gallon to 80 gallons of water may be used instead of dusting, but it is less effective. First dilute the oil emulsion with the water and then add the nicotine sulphate.

When first-crop alfalfa is severely attacked it should be closely clipped immediately and quickly removed from the field, and the field kept dry until after new growth starts. Granular calcium cyanide, 25 pounds per acre, sown on top of the ground in a grain drill, kills most of the aphids when alfalfa plants are small, but its use is impracticable excepting in extreme cases.

Clipping the alfalfa very close late in the fall or grazing it after the last crop is cut prevents heavy infestations from developing.

PEA WEEVIL. A small gray-brown beetle that lays its eggs on the outside of the pods. Grubs eat into the peas where they mature and pupate. Most of the adults emerge from the peas in the fall, but some of them remain in the seeds until the following spring. Weevily peas are readily recognized by the large, circular emergence holes. Adults fly long distances, some of them hibernate in trash in the field, in old pea vines, in cracks in fence posts, under bark of posts, trees, etc. There is one generation annually.

Control: If planting infested seed in new territory where the weevil does not already exist, fumigate it with carbon disulphide. (See under granary weevil, p. 24.)

All efforts at control should be concentrated in eliminating the escape, in the autumn, of weevils which would survive in hibernation to attack the succeeding year's crop. In commercial pea fields, several weeks usually elapse after the time the peas are ripe, before the first weevils emerge from the peas. Therefore, peas should be harvested as soon as ripe and placed immediately in tight bags to prevent the later escape of weevils. These bags should be fumigated before opening and all danger of infestations from harvested peas eliminated. Pea vines should be destroyed immediately after harvesting by plowing them under, or by burning. Any improvement in harvesting methods that reduces the percentage of shattering serves to reduce the population which will escape to attack the succeeding year's crops. After harvest, fields should be disced immediately to a depth of 3 or 4 inches to bury the weevily shattered peas and prevent escape of adults from them. Elimination of brushy or weedy areas along fence rows, roadsides, etc., materially aids in successfully reducing the number of weevils hibernating. In garden patches, care should be exercised to pull and destroy the vines as soon as the earliest peas are matured beyond the edible stage. If this were done generally, pea weevil populations would be held low, and consequently little injury would occur to garden peas.

PEACH BORER. The clear-winged moths deposit their eggs on the trunk of peach and prune trees near the ground. When larvae hatch, they make their way into the trunk just below the soil surface. They feed and grow in the trunk or roots beneath the ground, frequently completely girdling and killing the trees. Masses of semi-transparent gum exude from holes made by the larvae. Larvae are very light yellow, have a light brown head, and when mature are about 1 inch long. There is one generation annually.

Control: Smooth the ground around the base of the tree, lowering the level as little as possible. Spread a narrow ring of paradichlorobenzene entirely around, about 2 inches away from the trunk, cover with 4 inches of soil and pat down. Use ½ ounce of paradichlorobenzene for young trees; ¾ ounce to 1 ounce for trees 5 years old or older. The best results are obtained by making the application about September 15, after most of the eggs have been laid. Mounds should be leveled down to the general soil surface the following spring to prevent moths from laying their eggs high on the tree trunks. Applications may be made in the spring if the borers are causing severe injury and it is necessary to obtain protection, but fall applications make it unnecessary to apply spring control and eliminate the injury caused by overwintering borers.

PEACH LECANIUM. A brown, hemispherical scale adhering to the smaller branches. The insect under the scale sucks the sap and devitalizes the tree. Of relatively little importance in Idaho.

Control: This insect is readily controlled by the dormant oil emulsion or lime-sulphur sprays used in the control of San Jose scale.

PEACH TWIG BORER. These are uniformly brown colored larvae with a black head; the first segment of the body is black. The mature larva is slightly less than ½ inch long and has the appearance of having light and brown stripes alternating cross-wise of the body. There are two generations annually. The overwintering generation hibernates beneath the bark in the crotches of the branches and emerges about the time peaches bloom. These larvae attack the terminal twigs, killing and deforming them. A second generation bores into the fruits and is the principal cause of "wormy" peaches.

Control: Spray with lime-sulphur as for San Jose scale. Oil sprays are not effective. Lead arsenate, 4 pounds to 100 gallons of water, sometimes gives a high degree of control if applied just as larvae emerge in the spring, but it is difficult to time the application correctly and poor control often results.

PEAR LEAF BLISTER MITE. These nearly microscopic, pink colored mites live beneath the bud scales of apple and pear during the winter. They emerge early in the spring and begin feeding inside the leaves before they are fully

opened. They cause little blisters which are at first light green or red but which later turn to rusty brown. In late summer severely infested leaves are red and dry in appearance, and whole areas in the leaves are killed. Injured fruits are misshapen, rough, and russeted. Many generations develop in a season, all of them within the leaf tissue where they are not successfully reached by sprays.

Control: This mite is readily controlled with lime-sulphur sprays testing 3½° Baume. Spraying should be done before the leaves begin to unfold.

PEAR SLUG. Sticky, shiny, olive-green or nearly black larvae that move little and destroy the upper leaf surface, causing leaves to turn brown and become crisp. One generation attacks the foliage in the early spring and another in the fall.

Control: Spray with calcium arsenate, 2 pounds to 100 gallons of water, or dust the foliage lightly with calcium arsenate or hydrated lime. One application in the spring, as soon as injury begins to be noticeable, is sufficient. Another application in the fall may be necessary for control of the second brood.

PINE NEEDLE SCALE. Needles of pines sometimes are dotted with white specks. These are the scaly coverings of tender-bodied sucking insects. The purplish eggs of the insects may be found beneath the scales in the winter. The young appear some time in May and are red. They may be readily observed crawling about on the needles.

Control: Spray the infested trees with summer-type oil emulsion, 2 gallons to 98 gallons of water, about 10 days after the first crawlers are observed. This will be about the last of May or the first of June.

PRUNE LEAFHOPPERS. See "Apple Leafhopper," page 5.

RASPBERRY ROOT BORER. The adult is a clear-winged moth with a black body crossed by four narrow yellow bands. Eggs are deposited on the under sides of the leaves and larvae hatching from them make their way beneath the bark just below the ground level or under flakes of bark at the bases of stems. The following spring they tunnel beneath the bark of stems and roots, often girdling them and causing wilting stems or dying plants. They continue to grow until

the next spring when they are nearly 1 inch long. They pupate in their tunnels. The life cycle is two years.

Control: No satisfactory means of control is known. The only helpful procedure recommended is to dig the larvae out of infested plants and destroy them or to remove and burn infested bushes.

RED SPIDER (COMMON). This minute creature varies in color from translucent green to red. It winters in the soil as an adult and migrates to the growing plants in the early spring. It attacks many kinds of fruit trees, bush fruits, field crops and ornamentals. It is readily recognized by the fact that it spins a dense web, especially on the under sides of the leaves, beneath which it feeds. Eggs and all other forms of the mite are protected late in the season by this web. There are several gnerations annually. Injured leaves become dry and leathery, turn red or brown in color, and often fall prematurely. Damage is extremely severe and frequently results in small-sized fruit, reduced yield, and injury to the fruit spurs of trees which affects the next year's crop.

Control: Sprays applied to trees, etc., during the dormant season do not control the red spider, since at that time it is in hibernation in the soil, but when lime-sulphur is used as a dormant spray there appears to be a residual effect which helps to hold populations down. The use of summer-type oil emulsion, 1 gallon to 100 gallons of spray, in the calyx spray aids in control on apples. Summer-type oil emulsion added to the first or second codling moth cover sprays at the rate of 1 or 1½ gallons to 100 gallons of spray solution usually gives control of the red spider as well as of leafhoppers and greatly aids in codling moth control. Any plants to be protected must be sprayed as soon as the mites are found on them and before heavy webbing is formed, usually from about the middle of May to not later than June 15 in Idaho, depending on the locality. Spray applied after the heavy webbing is formed and severe injury becomes apparent on the leaves usually represents useless expense. Control of the red spider on any plants when codling moth or leafhopper control is not considered is accomplished by spraying thoroughly with summer-type oil emulsion at the rate of 1 or 1½ gallons in 100 gallons of spray solution.

Probably the best means of controlling red spiders on field crops, such as beans, clover, potatoes, etc., or on orchard cover crops, is by dusting the infested plants with dusting sulphur

at the rate of 25 pounds per acre. Dusting should be done on calm, warm days.

ROSE APHID. This pink or green colored plant louse frequently covers stems, buds, and young leaves, and secretes a sticky honey-dew. It frequently severely injures plants by sucking the sap. There are many generations annually.

Control: Spray with 40 per cent nicotine-sulphate, 1 teaspoonful to 1 gallon of water, in which is first dissolved a piece of soap the size of a large walnut. It is important to make applications as soon as the first aphids appear. Applications should be repeated as often as necessary.

ROSE CURCULIO. This red, snout-beetle is about ½ inch long. It causes injury by puncturing the flower buds so that the petals, when they unfold, are riddled with holes.

Control: Hand pick the beetles on or beneath the plants. Spray with Bordeaux mixture 6-6-50 (directions for preparation on page 69) to repel the beetles, making the first aplication when the first flower buds are developing and keeping the new buds covered as they form.

(ROSE) LEAFHOPPER. This slender sucking insect is only about 1/8 inch long. It is greenish yellow or pale yellow. Injured leaves are identified by the flecking and mottling which occurs around the leaf punctures. Severely infested leaves become crisp and dry. The young are wingless, very delicate creatures and are found on the under surfaces of the leaves. Injury is caused by both adults and young.

Control: Follow the recommendations for grape leafhopper. Leafhoppers migrate from non-sprayed plants, and it is usually necessary to repeat spray applications frequently to keep rose bushes in good appearance.

ROSE SCALE. Snow-white, nearly circular scales on the canes. This insect is rarely injurious.

Control: Spray with lime-sulphur, 1 gallon to 10 gallons of water, during the dormant season.

ROSY APPLE APHID. Pink or purplish plant lice roll apple leaves severely and cause dwarfed, misshappen fruits. Their attack is not restricted entirely to the new leaves and tender growth. Several generations develop in the spring.

The winter is passed in the egg stage on the bark of apple trees. Eggs hatch in the spring about the time that buds begin to swell.

Control: The rosy apple aphid must be controlled early in the spring before the leaves begin to curl. Some degree of control is obtained by the use of the regular dormant spray of oil emulsion or lime-sulphur as for San Jose scale if the application is made just before the buds burst. Better control results if 40 per cent nicotine sulphate is used at the rate of 1 pint in 100 gallons of either the oil emulsion or lime-sulphur spray solutions.

SAN JOSE SCALE. These are tiny, yellow insects that fix themselves on the bark or fruit of many kinds of fruit trees, shade trees, bush fruits, and ornamentals. They increase rapidly and kill the plants by sucking the sap. As the tiny insects grow, they cover themselves with an ash-gray secretion or scale nearly circular in outline. There are several generations each year.

Control: San Jose scale is controlled by oil emulsion sprays, using dormant-type oil emulsion at the rate of 4 gallons to 96 gallons of water, or by lime-sulphur at the rate of 10 to 12 gallons of liquid lime sulphur (testing 32° Baume) for each 100 gallons of spray solution. Home made lime-sulphur should be diluted to test from 4° to 5° Baume in the spray tank. Spray while plants are completely dormant. Five pounds of dry lime-sulphur is equivalent chemically to 1 gallon of 32° liquid lime-sulphur.

SAW-TOOTHED GRAIN BEETLE. This beetle is a common household pest. It is reddish brown, about 1/8 inch long, and derives its name from the notched fringe on each side of the body. The grub is yellowish white and marked on each segment of the body by a darkened area.

Control: The most practical means of protection is to keep all containers free of particles of grain, flour, etc., being sure that each time a new supply is placed in them that they are first cleaned out. Precaution should be taken that flour or other grain products do not collect beneath bins. A practical safeguard is to keep flour in the bag in the bin and keep the top of the bag rolled shut tightly. The insects cannot gain access through tighly woven sacking cloth. An additional safeguard is to keep sodium fluoride sprinkled beneath bins and pantry shelves. When it is necessary to clean up an infestation in the house, infested foods should be destroyed or

heated for a period long enough to insure their reaching a temperature of 140° F. This may be done by placing them in the oven. Bins, drawers, etc., may be washed with scalding hot water and then dried, or they may be heated over a stove or in an oven. Clean-up measures are satisfactory also in the case of grain bins, storage elevators, etc. They should be first thoroughly cleaned and scrubbed out and the cracks sprayed with gasoline or kerosene in time so these substances may evaporate before grain is stored in them again. Fumigation is sometimes necessary, but it can be used only in unoccupied buildings that are relatively air tight. Those wishing to fumigate should write the Idaho Agricultural Experiment Station for special instruction.

SEEDCORN MAGGOT. These cream-colored maggots are found in potato seed pieces and seed beans in the soil, particularly during cold, wet springs. They frequently injure planted beans, killing the plants entirely or causing light stands or a condition known as "baldhead."

Control: No direct control method is known. The flies which lay their eggs on the soil are known to be attracted by the presence of freshly decaying organic matter. In fields where potatoes are to be grown, it is best to turn under in the autumn the manure or green cover to be used as fertilizer rather than to do it in the spring before planting. Satisfactory stands and yields are obtained by replanting infested fields as soon as it is determined the first planting will be unproductive. By that time most of the maggots have developed and the second planting usually remains free of injury. Sometimes it is practicable to plant a field to beans a little earlier than the usual planting date, and then in about 10 days rework the field and plant the main crop.

SNOWBALL APHID. These are bluish colored plant lice that attack the leaves early in the spring, causing curled, deformed leaves and small, inferior blossoms. Winter is passed in the egg stage. Newly-hatched aphids attack the terminal leaves early in the spring. Injury is all caused early, for aphids fly away later and do not return to the snowball until autumn.

Control: Spray snowball bushes when the leaves first show green, using 40 per cent nicotine sulphate 1 teaspoonful, commercial oil emulsion, 20 teaspoonfuls, and water, 1 gallon, or spray with nicotine sulphate, 1 teaspoonful in 1 gallon of water, in which has been dissolved a piece of soap the size of a large walnut.

SNOWY TREE CRICKET. Green or yellowish "crickets" occuring most numerously on prune trees. Eggs are deposited in the bark on the under side of medium sized branches in the fall. They hatch about June 1. Feeding is generally confined to the leaves until about July 25 or when the first prunes begin to show color. Crickets then attack the fruit, eating holes of various sizes into it. The first adults develop about the middle of July, after which time males may be heard chirping in unison in infested trees. There is one generation annually.

Control: Dust the trees with undiluted calcium arsenate at the rate of about 0.14 pounds per tree or spray with calcium arsenate, 2 pounds to 100 gallons of water. A spreader should be used with sprays to prevent spotting the fruit. Application should be made between July 15 and August 1. One application completely protects the fruit and so reduces the population that spraying is not necessary again for several years.

SOWBUGS. These grayish, fat-bodied, fringed, slow-moving creatures attain a length of about ½ inch. They may be found near the ground under trash, leaves, or bits of manure. They cause injury by feeding on tender stems or leaves near the ground.

Control: They are controlled by means of a poisoned bait. The formula suggested on page 74 may be used, but the amount of molasses should be doubled and the bait made rather sloppy. Another bait is prepared by mixing 1 part of Paris green with 9 parts of granulated sugar. This bait is sprinkled lightly along the edges of benches and walks.

SPRUCE GALL APHID. This plant louse is grayish green, bluish green, or purplish blue, and is covered with a white powdery substance. It passes the winter in the immature form clustered in crevices of the stems about the bases of the buds. As soon as tree growth starts in the spring, the aphids settle at the bases of the developing branch buds and cause the formation of the "pine apple" galls which stunt the growth of spruce trees and cause an unsightly appearance.

Control: Almost complete protection from gall formation is obtained by spraying the trees with nicotine sulphate, 1 pint to 100 gallons of water, in which has been dissolved 5

pounds of laundry soap, or with lime-sulphur, 1 gallon to 40 gallons of water or with dormant-type oil emulsion 1½ gallons to 98½ gallons of water. Lime-sulphur causes staining of the foliage which gives it an unsightly appearance but causes no injury. Make the application in the spring just before new growth starts on spruce trees.

SQUASH BUG. Adult squash bugs are pale or dark grayish brown on the back, and the protruding margins of the abdomen are orange or alternately striped with orange and brown. The length of the body is about ⅝ inch. Eggs are whitish yellow to brown and are laid in clusters on the under sides of the leaves. The young are pink to gray and are often covered with a whitish powder. Both adults and young suck the sap and cause plants to wilt or die.

Control: The best means of reducing infestations is to burn all refuse in the fall under which the insects are hibernating. Place small strips of boards on the ground both before and after the crop is planted, and early in the morning, while the bugs are sluggish, destroy the bugs collected under the boards by dropping them into kerosene. Hand pick and destroy adults on the plants. Hand picking of nymphs and eggs is quite effective in small areas. Young nymphs may be killed by spraying them with nicotine sulphate, 2½ teaspoonfuls to 1 gallon of water, in which has been dissolved a piece of soap the size of a large walnut.

STONE FLY. This species is black colored with red and yellow markings and measures between ½ inch and ¾ inch long. Larvae live in streams and emerge in the early spring leaving their cast skins on rocks and bushes. Occasionally the flies make their way to apricot and peach trees and cause severe injury by eating holes in the forming fruits and into the fruit buds.

Control: Control probably can be obtained by spraying the trees with lead arsenate as soon as the insects appear on the trees.

STRAWBERRY CROWN MOTH. Adults are black, clear-winged moths varying in length from about ½ inch to ¾ inch. They are marked across the body by from 2 to 4 yellow bands. The caterpillars are whitish or pink with a brown head, and when mature are about 4/5 inch long. They kill strawberry plants by working in and destroying the crown, and so weaken other plants that they reduce the yield.

Control: No satisfactory control is known.

STRAWBERRY LEAF ROLLER. The small, green caterpillars feed on the upper leaf surfaces, first rolling the leaves together and feeding within. Leaf surfaces are so badly destroyed that leaves turn brown and dry and in heavy infestations fruits fail to mature. Moths appear in the spring and deposit their eggs on the under surfaces of the leaves. There are probably two generations annually in Idaho, but only the first generation is of economic importance.

Control: Spray the plants heavily with lead arsenate, 3 pounds to 100 gallons of water, before the caterpillars begin to roll the leaves, which is shortly after the moths begin flying, or about the time the plants are blossoming.

STRAWBERRY ROOT WEEVIL. These dark brown to black snout beetles are about ¼ inch long. They hibernate under leaves or trash, appear in early summer and lay eggs for the succeeding generation. Adults feed at night. Besides attacking strawberries, they kill the terminal buds of raspberry canes and probably injure other plants. The small, white, brown-headed larvae live in the soil and seriously injure or kill strawberry plants by feeding on the roots.

Control: Apply about 1 tablespoonful of poisoned bait in the crown of each plant when about 75 per cent of the weevils in the soil have changed to the adult stage. This is approximately three weeks before the final harvesting of annual-bearing varieties. Grind apple waste or pomace or dried apples through a meat grinder and then mix with it calcium arsenate at the rate of 5 pounds to 95 pounds of ground apple. Adults feed on this bait, and are killed before they deposit eggs, thus insuring protection of the next year's crop.

TERMITES. These so-called white ants occasionally destroy foundation timbers and woodwork in Idaho. They work in the dark, avoiding the light, and often their presence is unsuspected until injured timbers collapse. The species commonly destructive in Idaho maintain a ground connection and the insects travel back and forth from infested timbers in covered runways.

Control: Where timbers are found to be infested, destroy the covered runways and blow into the runways in the wood Paris green, finely divided white arsenic, or sodium fluosi-

licate. To do this bore ¼ inch holes in the infested timbers at 3- to 6-foot intervals so that the holes cut through the termite galleries and from one-half to three-quarters through the wood. Use a dust gun with a spout that fits tightly into these holes. Treat the ground at the base of these runways with sodium fluosilicate. The materials mentioned are extremely poisonous to humans, and must be handled with care. Immediately after handling the poison the hands should be washed. Wherever possible, replace old wooden foundations with concrete and in constructing new buildings use concrete foundations, or, if wood must be used, the most permanent known practical method of treating it is to use coal-tar creosotes.

THISTLE APHID. Red or green plant lice that curl the leaves of plums and prunes in the early spring and form sticky honeydew. Heavy infestations are extremely injurious and cause dropping of small prunes.

Control: Infestations are of no economic importance in orchards sprayed in the dormant period with oil emulsion for San Jose scale. After the foliage is out spray with 40 per cent nicotine sulphate, ¾ pint, summer-type oil emulsion, 1 gallon, and water, 99 gallons. Make applications just as the leaves are appearing and before curling of the leaves takes place.

TOMATO PSYLLID. This jumping plant louse sometimes injures potatoes in Idaho, causing a condition known as psyllid yellows. The adult is only about 1/32 inch long, light to dark brown, with the head and thorax black with white lines and spots. The young are yellowish or orange. There are probably three generations annually. It is probable that the insect hibernates in remote areas and flies to potatoes in the spring.

Control: Experiments by the Colorado Agricultural Experiment Station indicate that the insect is satisfactorily controlled by spraying the potato plants with standard liquid lime-sulphur at the rate of 1 gallon to 40 gallons water when the disease first begins to appear. Another application may be necessary later in the season. Tomatoes are more susceptible to injury, so when lime-sulphur is used to protect them from the psyllid it should be used at a dilution of 1 gallon to 50 gallons of water.

TOMATO WORM. This large green worm, having a "horn" on the rear end of the body, rarely occurs in numbers, but a few of them may cause heavy defoliation. The adult is known as a hawk moth and is one of the species frequently observed late in the evening feeding in the blossoms of many kinds of plants. It suggests a humming bird in the way it hovers and feeds in flowers.

Control: Hand-pick and destroy the caterpillars, or, in extreme cases, spray with calcium arsenate, 2 pounds to 100 gallons of water.

TREE HOPPERS. Tree hoppers cause injury to many kinds of fruit trees and ornamentals. The injury is caused by the wounds and scars made by the female in laying her eggs in the bark of trees. The scars may be long longitudinal slits, crescent-shaped or roughened and ragged appearing, depending on the species of tree hoppers making them. Egg slits are made in the current season's growth or in year-old wood but old scars persist for several years. Injury is most severe in young orchards having alfalfa or clover cover crops or in orchards which are very weedy. Injury may be especially severe around the edges of orchards where willows or weeds are allowed to grow.

Control: Clean cultivation is the most practicable method of control. It should be followed in old orchards for a season or two to cut down the infestation and should be practiced generally in young orchards until trees are well established. The success of this treatment depends on the fact that tree hoppers feed only on cover crops or weeds and only go to the trees to lay eggs. Many twigs containing eggs may be pruned off during the winter and burned to prevent emergence of young tree hoppers. Many of the eggs are killed by spraying the trees thoroughly with dormant-type oil emulsion at the rate of 5 gallons to 95 gallons of water before the buds burst in the spring.

(VIRGINIA CREEPER) LEAFHOPPER. These sucking insects are extremely abundant and injurious to Virginia creeper in many parts of Idaho. Adults are about 1/8 inch long, yellowish, and marked by a brown zigzag line lengthwise on each wing. Injured leaves are at first marked by light flecks. As injury progresses the flecking becomes more general and severely injured leaves assume a white, parched appearance. In the late summer, severely damaged vines are more or less defoliated.

Control: Control measures recommended for the grape leafhopper are effective. Also spraying with concentrated pyrethrum extract, 1 pint to 100 gallons of soapy water, is very effective, killing both nymphs and adults. The chief difficulty in obtaining control is the continuous influx of leafhoppers from non-sprayed vines to those that have been sprayed, and applications have to be repeated frequently to assure protection. It is advisable to spray all the infested vines in a neighborhood at the same time to prevent this migration.

WESTERN BLACK FLEA BEETLE. A tiny, shiny, black beetle that hops. It eats holes in leaves of cabbage, radish, and related vegetables or injures plants while in hot beds or shortly after planting.

Control: Dust the plants thoroughly with a mixture of barium fluosilicate or calcium fluosilicate, 1 part, and flour, 3 parts. Or, dust them with 2 per cent nicotine dust (see page 75 for preparation directions). Or, spray with Bordeaux mixture 6-6-50 (see page 69 for preparation). Begin dusting while plants are in hot beds or immediately after they are set out, or when they appear above the surface in seeded fields. Repeat applications until danger of injury to young plants is past.

WESTERN POTATO FLEA BEETLE. Small, shiny, black beetle that hops. It eats holes in the leaves of young potato and tomato plants, causing leaves to turn brownish and become crisp.

Control: Apply the same control measures as for the western black flea beetle.

WHITE GRUBS. These are larvae of the June bugs, the ten-lined beetle, and the carrot beetle. They are large, brown-headed grubs that eat the roots of plants below the soil surface. Grubs usually are found in a curled position when dug out of the ground. The adults are large, red beetles measuring from about ½ to ¾ inch long. The ten-lined beetle is grayish with 10 black lines running lengthwise on the back. Adults are often attracted to lights in the summertime and make a loud buzzing noise when in flight.

Control: Avoid planting crops susceptible to white grub injury on recently broken sod. Pull affected plants and destroy the grubs to prevent them from attacking adjacent sound plants. Injured plants are detected by their wilted appearance.

WHITE-LINED SPHINX. The large moths feed at dusk on the nectar of many kinds of flowers, hovering about the flowers like humming birds. Caterpillars attain a length of 3 inches, and may be either green or nearly black. They have a horn at the rear end of the body. The horn and the head are orange or yellow. They are general feeders, but have been occasionally injurious to alfalfa and wheat in Idaho.

Control: This species is so heavily parasitized that it rarely becomes injurious and probably never in successive seasons in the same locality. Alfalfa fields may be mown as soon as infestations become heavy. The attack soon subsides and later injury is not probable.

WIREWORMS. These shiny, yellow, hard worms bore into planted seeds, corn, beans, potato seed pieces, and into potato tubers, root crops, and the underground portions of many other plants. The loss caused by them is enormous and is steadily increasing in the irrigated sections of Idaho. The adults are slender brown or black, hard-shelled beetles known as click beetles from their habit of springing into the air and making a clicking noise when they are placed on their backs. Wireworms live in the soil several years before transforming to adults. Adults are present for but a short time in the spring during mating and egg-laying. The inaccessibility of the larvae in the soil renders control difficult and extremely costly.

Control: No general satisfactory method of control is known. Experiments of the Bureau of Entomology during recent years show that a high degree of kill of wireworms in the soil may be obtained by the use of carbon disulphide or crude naphthalene. Best results with chemicals are obtained only when the soil is plowed and put in a good tillable condition before treatment and when the soil temperature is above 70° F. when treatment is made.

When carbon disulphide is used, the ground should be first plowed deeply, smoothed lightly afterward, and marked off in 2-foot squares. At the intersection of the marks, holes should be punched with a stick to a depth of 3 or 4 inches. Apply 1 fluid ounce of carbon disulphide in each of these holes and immediately cover with damp soil, pressing it down tightly with the foot. After 5 days plow the soil again and prepare for planting.

When crude naphthalene is used, the ground should be plowed as deeply as possible, three-quarters of the naphthalene at the same time being sprinkled in the furrow and on the

furrow slice. The remaining one-fourth should be sprinkled on top after the plowing is finished, and the whole field should be immediately disked as deeply as possible. Under this procedure it is necessary to use at least 800 pounds of crude naphthalene per acre to obtain a good kill of wireworms. After the lapse of five days, seed may be planted without danger of injury. The cost of treatment by means of crude naphthalene is about one-half that of carbon disulphide or from about $25 to $30 per acre, exclusive of labor.

Two natural and comparatively inexpensive control measures may be practicable to use under some conditions. Wireworms can be killed by two extremes of moisture, drowning and desiccation. Flooding wireworm infested land for a period of a week, when the temperatures are high in the middle of the summer, will reduce wireworm populations to almost nothing. Flooding is not practical except in the extremely hot periods, usually occuring once or twice each year in July and August. Killing wireworms by drying out of the soil will probably have an even wider application and will work in with the usual farming methods to a greater extent. By using wheat or alfalfa, without irrigation, to dry out the soil, it is entirely possible to reduce wireworm populations below those causing commercial damage.

WOOLLY APPLE APHID. This purplish plant louse clusters in crevices or wounds in the bark or on the roots and is covered by a white, "woolly" secretion.

Control: Spray infested trees thoroughly about the middle of June with a solution composed of 1 pint of 40 per cent nicotine sulphate, 1 gallon of summer-type oil emulsion, and 99 gallons of water. The oil and nicotine may be added to one of the first-brood codling moth cover sprays. The spray solution must be applied with sufficient pressure to drive it through the woolly covering and to the aphids beneath.

ZEBRA CATERPILLAR. Black and yellow striped caterpillars that feed in colonies. They are found first in clusters and defoliate single plants before spreading to others.

Control: Destroy colonies on the leaves or spray as for cabbage worm.

Plant Diseases

ALFALFA CROWN AND STEM ROT. This disease has been found in some of the more humid, non-irrigated parts of Idaho. It attacks the various clovers as well as alfalfa. The stems and crown are attacked and rot off, the injury is most severe in the early spring. Numerous black sclerotia, the resting stage of the causal fungus are to be found on the stems and crowns of the diseased plants. (fungus)

Control: This disease has not been severe enough to warrant the application of control measures.

ALFALFA CROWN WART. Warty outgrowths at the crown of the plant. Plants dwarfed. (fungus)

Control: Plow under badly diseased areas and do not plant to alfalfa for several years.

ALFALFA DOWNY MILDEW. Produces a gray mildewed growth on the leaves. May weaken the plants and cause dropping of the leaves. More severe in wet weather. (fungus)

Control: No satisfactory control known. Excessive irrigation should be avoided.

ALFALFA LEAF BLOTCH. Yellow blotches covered with tiny dark spots appear on the leaves. Entire leaf often affected. (fungus)

Control: In severe cases, hay should be cut and cured as as soon as possible in order to save the leaves.

ALFALFA LEAF SPOT. Dark brown circular spots on the leaves. Causes dropping of the leaves in severe cases. (fungus)

Control: Same as for leaf blotch.

ALFALFA STEM BLIGHT. A disease attacking the stem of the alfalfa plant causing a spotting and in severe cases a rotting of the stems. (bacterial)

Control: No satisfactory control known.

ALFALFA WHITE SPOT. White spots appear on the leaves of alfalfa plants. Usually only certain areas of a field

may be affected. This condition may be confused with frost injury. (non-parasitic)

Control: As the trouble is doubtless caused by unequal supply of soil moisture, careful attention to irrigation, keeping an even supply of moisture available will prevent white spot.

ALFALFA BACTERIAL WILT. The most destructive disease of irrigated alfalfa in Idaho, causing death of plants and loss of stand in older fields. Affected plants are dwarfed and spindling, and have many small stems giving the plant a "witches broom" appearance. Plants often wilt in hot weather. (bacterial)

Control: Badly affected fields should be plowed and other crops grown for two or three years. Avoid infecting new stands of alfalfa by drainage, or irrigation water, or by transporting materials from infected fields. Avoid close grazing and cutting of alfalfa while wet. Certain varieties of alfalfa are more resistant than others. Write to the Idaho Agricultural Experiment Station for information regarding resistant varieties adapted to your locality.

APPLE BLUE MOLD ROT. Widely distributed and one of the most common storage rots. Rot starts at bruises or skin punctures. Blue fungus growth soon appears on the surface of rotted areas. (fungus)

Control: Handle apples carefully, cool rapidly and keep in cool storage. Thorough drying after washing is important.

APPLE WATER CORE. Characterized by glassy or watery appearance of the flesh of the apple. Certain varieties are more susceptible than others. Caused by growth conditions in the orchard which tend to increase sap concentration. (non-parasitic)

Control: Avoid over maturity of apples before picking.

APPLE DROUGHT SPOT. Large, firm, corky areas develop in the flesh of the apple. Usually associated with intense sunlight and with shallow or open soils. (non-parasitic)

Control: Difficult to control. Increasing water-holding capacity of the soil will reduce losses from this disease.

APPLE POWDERY MIDEW. Mildew growth comes on tips of branches and the leaves are curled and dwarfed. Death of tips of twigs often results. (fungus)

Control: Prune infected shoots. Spray with lime-sulphur summer strength, same as for apple scab.

APPLE PERENNIAL CANKER. Perennial canker occurs around wounds due to pruning cuts, frost cankers, and woolly aphis injury. The disease spreads from year to year forming deep, ugly cankers with concentric rings formed by the spread of the parasite each year. (fungus)

Control: The spread of perennial canker has been definitely connected with woolly aphis injury. Control of this disease therefore depends upon the control of woolly aphis.

APPLE SCAB. This disease is common only in the northern part of Idaho. Causes scabby spotting of fruit and olive colored spots on the leaves. Fruit is often misshapen. The organism causing the disease over-winters on old leaves under the tree. (fungus)

Control: Destruction of old leaves in the fall or early spring is advisable. Spray with lime-sulphur summer strength: (1) when blossoms show pink; (2) when 80 per cent of the petals have fallen, and again, (3) three weeks later. The last two sprays will be combined with codling moth sprays.

APPLE SOFT SCALD. This disease occurs upon the apple fruit in storage. The scalded areas turn brown in color, the tissue is soft, and the line of demarcation between diseased and healthy tissue is sharp. (non-parasitic)

Control: Place in storage as soon as possible after picking and provide good ventilation.

APPLE SCALD. As the name indicates, this disease causes a brown scalded appearance of the green side of the apple fruit. It is a non-parasitic disease caused by unfavorable conditions during growth and storage. (non-parasitic)

Control: Low temperatures and prompt cooling help to delay the development of scald. Oiled wrappers, or oiled blotter material will absorb the injurious gases given off by the fruit in storage and prevent scald.

APPLE TREE ROSETTE. Rosette is common throughout Idaho, especially in orchards which have been clean cultivated for several years. A rosette of leaves forms at the tips of affected branches, the rest of the branch in many cases being entirely bare of leaves or covered only with small scale-like leaves clinging closely to the branch. Affected trees become stunted and often die. (non-parasitic)

Control: Where sufficient soil moisture is available, alfalfa grown in the orchard will correct the conditions causing rosette. One tablespoon of zinc sulphate crystals injected into the trunk near crown at 4-inch intervals has been found helpful in correcting this condition when alfalfa can not be grown.

ASTER WILT. This disease is caused by a fungus which over-winters in the soil and attacks the aster plants through the roots and stem. The base of the plant turns black and the entire plant soon wilts and dies. (fungus)

Control: Destroy all diseased plants and use new ground for asters each year when possible.

ASTER YELLOWS. As the name indicates this disease causes a yellowing of the leaves. The whole plant presents a sickly, stunted, and spindly appearance. (virus)

Control: Yellows is a virus disease transmitted only by a leafhopper. Diseased plants should be destroyed at once.

BARLEY SMUT (COVERED). A fungus disease, the brown spore masses of which take the place of the kernel. This fungus mass retains somewhat the shape of the kernel and is to be found in the threshed grain. Spores become lodged on healthy kernels and infect the barley plant in seedling stage. (fungus)

Control: Treat seed with a solution of 1 pint of formalin to 40 gallons of water, dipping it for 5 minutes or sprinkling it until every kernel is wet. Dry and sow at once.

BARLEY SMUT (LOOSE). This disease differs from covered smut in that the spore masses break away from the head leaving the bare stalk. Spores are blown by the wind from diseased to healthy heads soon after plants head out and the fungus enters and remains on the inside of kernel. These kernels produce smutted plants. (fungus)

Control: Secure seed free from the disease if possible. Hot water treatment is the only known method of control. This treatment is not recommended except for a small amount of seed for seed plot.

BARLEY STRIPE DISEASE. Caused by a fungus which over-winters in the seed. Plants dwarfed, leaves striped and heads often destroyed. Whole plant attacked and usually killed. (fungus)

Control: Use disease free seed.

BEAN ANTHRACNOSE. Conspicuous symptoms on pods, reddish brown spots gradually become sunken at the center, surrounded by a rusty to dark-brown colored border. Spots may occur on any part of plant above the ground. (fungus)

Control: Use disease free seed (Western grown), or resistant varieties. Rotate.

BEAN BACTERIAL BLIGHT. Watersoaked spots on leaves and pods develop into brown lesions, often causing defoliation. Cankers on main stem cause breaking. (bacterial)

Control: Use clean seed (Idaho grown). Rotate.

BEAN BALDHEAD. Young plants without terminal bud. Secondary growth may arise from cotyledonary node. Caused by mechanical injury to seed or by maggots in germinating seed. (non-parasitic)

Control: Care in threshing to prevent undue mechanical injury. Avoid planting in cold damp soil. Spring plowed clover or alfalfa ground conducive to maggot injury.

BEAN DRY ROOT ROT. Wilting of leaves and reddish brown discoloration of the taproot. Lateral roots shrivel and become dry. (fungus)

Control: Irrigation to stimulate development of lateral roots above diseased area. Crop rotation is essential to prevent fungi accumulating in the soil.

BEAN MOSAIC. This disease is carried by infected seed and spread in field by aphids and perhaps other insects. Leaves

mottled and curled. Plants dwarfed and produce only a few small pods. (virus)

Control: Use resistant varieties if possible or secure disease free seed.

CELERY LATE BLIGHT. Leaves and stems covered with dark brown spots on which later appear the fruiting bodies of the fungus causing the disease. (fungus)

Control: Spray with Bordeaux 5-5-50 or dust with copper lime 20-80 in seed bed when plants are one inch tall and again just before transplanting. Follow this by the same treatment in the field each week until ten days before harvest.

CHERRY POWDERY MILDEW. Causes characteristic white powdery growth on leaves with small black fruiting bodies of the fungus appearing later in the season. (fungus)

Control: Same as for apple powdery mildew.

CHLOROSIS (LIME INDUCED). This condition is very common in irrigated regions of southern Idaho on nearly every kind of tree and shrub. It is sometimes also found on herbaceous plants. The leaves of affected plants turn yellow and the plants often present an unthrifty stunted appearance. Part or all of the plant may be affected. This type of chlorosis is caused by a lack of available iron. The excess lime in the soil renders the iron unavailable for use by the plant. (non-parasitic)

Control: Iron may be supplied to the diseased plants by spraying or injecting iron salts into the plants. This will give temporary correction lasting for a year or two. Correction of irrigation practices, deep cultivation, and addition of humus to the soil will assist materially in eliminating chlorosis. Write to the gricultural Experiment Station for more detailed information.

CLOVER NEMATODE OR EELWORM. Tiny worms, hardly visible to the naked eye, that attack the plant at the crown, causing swelling of the stems at the bases of leaves. Much winter killing induced by eelworms. See Idaho Experiment Station Bulletin 130. (eelworm)

Control: Infected field should be plowed up not later than third fall after seeding.

CLOVER POWDERY MILDEW. This disease is rapidly becoming very serious in Idaho. Causes white mildewed appearance of leaves. Reduces vigor of plants and reduces set of seed. (fungus)

Control: Dust with fine dusting sulphur, 10 to 15 pounds to the acre, when plants are 4 to 6 inches high. Make further applications as necessary. Or, use lime-sulphur, 1½ gallons to 100 gallons of water, for each 1½ acres.

CLOVER RUST. Brown rust spots appear on leaves and stems. Rusty powder, the spores or seeds of the rust fungus is often in evidence on and around diseased plants. (fungus)

Control: No satisfactory control is known for this disease.

CORN COMMON SMUT. This disease produces black smut balls on various parts of the plant above ground. (fungus)

Control: Remove and destroy diseased portions of the corn plant. The smut fungus over-winters in the soil and in manure. It is not carried by the seed.

CORN HEAD SMUT. Head smut differs from common smut in its effect upon the corn plant in that the black smut balls appear only on the ear or tassel. The smut balls are more compact in this disease and retain their shape as a definite ball much longer than in common smut. This disease may also attack sorghum. (fungus)

Control: Head smut is controlled by the same measures as common smut. General sanitation and prevention of spread of smut by means of manure are important.

CROWN GALL. This disease attacks many different plants; orchard trees and small fruits are very often diseased. The disease causes galls at or just below the surface of the ground. These galls are irregular, warty and of various sizes, often being larger than the diameter of the trunk. Diseased trees may become stunted after planting in the orchard. (bacterial)

Control: All nursery stock should be carefully examined and only plants free from this disease should be used. Diseased trees in the orchard should be removed and destroyed. All

dirt and small roots should be removed from the hole before another tree is planted.

CURLY-TOP. Curly-top was originally described on beets and is of major importance on this crop in Idaho. The disease is transmitted only by the beet leafhopper. It occurs also on many other plants and is sometimes destructive on beans, tomatoes, cucumbers, squash, and pumpkins. Leaves are curled and yellowed and soon die. The entire plants often die early in the season. (virus)

Control: Resistant varieties and selections of crops not susceptible to curly-top is the most satisfactory means of control. Write for detailed information.

DAHLIA MOSAIC. This disease causes a mottling of the leaves, stunting and dwarfing of the plants. Other causes may produce stunted plants. Mosaic infected plants never recover. (virus)

Control: Remove and destroy affected plants as soon as symptoms appear.

DAMPING-OFF. The condition known as damping-off is very common on numerous plants when grown in the greenhouse or in a hot bed. Various fungi may attack the seedling plants at the surface of the soil and cause them to wilt and fall over. Damping-off of sugar beet often causes serious loss under field conditions in southern Idaho. (fungus)

Control: Cultural practices which will prevent formation of a crust on the surface of the soil will help to prevent damping-off in sugar beets. Damping-off of seedlings in the green house and hot beds may be prevented by sterilizing the soil and by good ventilation, as the fungi which cause this condition are favored by high humidity. Certain organic mercury compounds recently placed on the market give quite effective control of damping-off without injury to the seedling.

DELPHINIUM POWDERY MILDEW. Characteristic white powdery fungus growth appears on the leaves and stems of both annual and perennial larkspur or Delphinium. (fungus)

Control: Sulphur dust applied as soon as the disease first

appears and repeated at 10-day intervals will keep this disease in check.

DELPHINIUM WITCHES BROOM. As the name indicates, the whole plant has a bushy, witches broom appearance. Flowers do not open and the whole plant is stunted and yellowed. (virus)

Control: Remove and destroy all plants as soon as they show symptoms of the disease.

ERGOT. Causes black or brown bodies to form in place of kernels of grains. These ergot bodies are poisonous to animals when fed with the grain. (fungus)

Control: Secure clean seed if possible. If necessary to plant grain containing ergot, pour the grain into a salt solution (20 per cent to 30 per cent) and skim off the ergot.

FIRE BLIGHT. This is a very serious disease of apples, pears, and quinces. It kills the blossoms, twigs, branches, and sometimes the whole tree. The disease is known as blossom blight, fruit blight, twig blight, body blight, collar blight, or root blight depending upon the part of the tree attacked. Bacterial germs of the disease over-winter in cankers on larger limbs and are carried by insects to blossoms and smaller twigs. Cankers usually occur at bases of twigs, are diamond shaped, and delimited by a crack in the bark. (bacterial)

Control: All hold-over cankers should be removed. In pruning cut back at least 6 inches beyond any discoloration of the bark. Susceptible varieties should be avoided if possible. Trees should not be forced too rapidly as succulent growth is more readily attacked by disease germs.

GLADIOLUS HARD ROT. Irregular, dark, rotted areas appear on the corms. The entire corm may be affected. Spots may appear on the leaves in the center of which are small black bodies, the fruiting stage of the causal fungus. (fungus)

Control: Carefully discard all diseased corms. Rotate.

GLADIOLUS SCAB. Circular, shallow, dark depressions occur on the corms. The surface of the diseased area is usually shiny. Brown streaks or spots occur on the husks. Sometimes

causes rotting of leaves at the surface of the soil. (bacterial)

Control: Soak corms in corrosive sublimate, 1-1000, for two hours. Certain organic mercury compounds are also effective in controlling scab. Do not plant gladiolus in the same soil more than once in four years.

GOOSEBERRY POWDERY MILDEW. Produces white cobwebby growth on leaves and fruit. (fungus)

Control: Three or four applications of lime-sulphur, 1½ gallons to 50 gallons of water, beginning as soon as leaf buds open.

GRAIN RUSTS. All of the common grains and many wild grasses are attacked by these diseases. One species of host may become infected by several species of rust fungi. The leaves, culms and in severe cases the glumes are attacked. Open blisters appear on the affected parts. These are filled early in the season by yellowish to reddish dust, (red rust stage). Later when the grain begins to mature the blisters are filled with a black powder, (black rust stage). (fungus)

Control: Use resistant varieties. The use of sulphur as a dust retards infection.

HAIRY ROOT. Originally thought to be caused by the same organism causing crown gall. Causes excessive development of hairy roots on various kinds of fruit trees and shrubs. (bacterial)

Control: Secure disease free nursery stock. Dig and destroy all infected plants at once.

HOLLYHOCK RUST. Leaves covered with yellow to brown rust pustules. (fungus)

Control: Remove and destroy affected leaves. Dust with sulphur in the spring.

IRIS LEAF SPOT. This disease appears first as small brown spots on the surface of the leaf. These spots enlarge rapidly and the leaves may be killed by the disease. (fungus)

Control: The causal fungus over-winters on the leaves. Sat-

isfactory control may be secured by removing and destroying all diseased leaves in the fall.

IRIS SOFT ROT. Soft rot of iris is caused by the same organism which produces soft rot of vegetables. The rot on the rhizomes of the iris usually occurs in the spring, and the first symptoms of the disease are a slight wilting of the leaves. The leaves may later turn yellow and die. (bacterial)

Control: Badly diseased plants should be destroyed. Rotted portions of the rhizomes may be carefully cut away. All rubbish and soil should be kept away from the top of the plant. Copper carbonate dust sprinkled on the plants may help in preventing the disease.

LETTUCE TIP BURN. Edges of leaves turn brown and die. Sometimes accompanied by decay. (non-parasitic)

Control: No control known under field conditions. In greenhouse avoid excess moisture and high temperature.

MUSHROOM ROOT ROT. Appears on shade and fruit trees and occasionally on such crops as raspberries or strawberries. Attack is centered at the crown and on the roots. Rotted areas occur at these points, resulting in a decreased vigor of the tree. Occasionally groups of mushrooms will appear in the neighborhood of the base of the tree.

Control: Resolves itself into a combination of tree surgery and eradication of affected trees.

OAT SMUT. Heads smutty. Floral parts destroyed and masses of black smut spores produced. (fungus)

Control: Spray seed with formalin, 1 part to 10 parts of water, using a quart sprayer. Cover oats one hour after treating.

ONION NECK ROT. Soft decay starts at neck and spreads rapidly downward. (fungus)

Control: Cure crop as rapidly as possible. Avoid exposure to rain after harvest. Keep storage dry and cool.

ONION SMUT. Swellings appear on leaves which later break open exposing the black smut spores. (fungus)

Control: Use formalin drip method for control. See United States Department of Agriculture Bulletin No. 1060.

PANSY POWDERY MILDEW. The white powdery growth characteristic of the powdery mildew may appear on the pansy leaves any time during the summer. The disease may be also on the flowers. (fungus)

Control: Fine dusting sulphur applied periodically will prevent the occurrence of this disease.

PEA BACTERIAL BLIGHT. Water-soaked spots appear on any or all aerial parts. Spots small at first and finally turn brown to black. May be spread by hail or driving rains. (bacterial)

Control: Use disease free seed.

PEA FUSARIUM WILT. Often appears in fields in roughly circular spots. Plants pale yellow-green, and stunted. Leaves wither and shrivel. Plants eventually die. Outside of tap-root tends to be normal, inside often discolored. (fungus)

Control: On wilt infested soil use resistant varieties. Resistant Alaska, resistant Perfection, and other resistant varieties have been developed.

PEA POWDERY MILDEW. Gray cobwebby growth on leaves, pods, and stems. (fungus)

Control: Early planting and proper drainage. Dust with sulphur.

PEA ROOT ROTS. Reddish brown to black lesion in region of seed attachment progressing upward to soil line. Rotted area may encircle the whole stem. Leaves gradually yellow and in severe cases death follows. (fungus)

Control: Rotation essential to prevent fungi accumulating in the soil. Avoid return of straw to soil.

PEACH BLIGHT (CALIFORNIA PEACH BLIGHT). The fungus causing this disease attacks peaches, apricots and cherries, causing a shot hole of the leaves, a serious twig blight and canker of the twigs, and a scabby spotting of the fruit. (fungus)

Control: Control is easily effected by the application of Bor-

deaux mixture 6-6-50 applied as a dormant spray as soon as the leaves have fallen in the autumn.

PEACH LEAF CURL. Young leaves and shoots reddened, swollen, and distorted. (fungus)

Control: Spray with lime-sulphur winter strength or Bordeaux mixture 6-6-50 when trees are dormant; must be done before buds swell.

POTATO BLACKLEG. Causes the stems of the plant to turn black and the leaves to roll and become yellowed. Soft rot of stem and tubers develops later. (bacterial)

Control: Use only seed from disease free fields if possible. Seed treatment will aid in control of this disease.

POTATO CALICO. In this disease leaves of all or portions of potato plants are bright yellow in color. Only portions of an individual leaf may be yellow. These yellow areas later turn brown. (virus)

Control: Calico plants should be rogued from potatoes to be used for seed as the disease is transmitted by the seed tubers.

POTATO COMMON SCAB. Scabby spots appear on the tubers. (bacterial)

Control: Rotate crops and treat seed with hot formalin or corrosive sublimate.

POTATO FUSARIUM WILT. A disease causing rapid wilting of plants in dry, hot weather. Internal discoloration of stem often present. (fungus)

Control: Rotate crops. In sections where disease is severe, plant only whole potatoes.

POTATO LEAF ROLL. Leaves rolled upward, papery, brittle, and yellowish or reddish in color. (virus)

Control: Same as for mosaic.

POTATO MOSAIC. There are several types of mosaic. They cause either mottling, crinkling, streaking of the leaves, or dwarfing of the plants and are carried from year to year by tubers and transmitted in the field by aphids. (virus)

Control: If possible use only high grade certified seed and keep it free from disease by means of well isolated and carefully rogued seed plot. Have seed tubers indexed for disease free source of seed.

POTATO RHIZOCTONIA. Black resting bodies of the fungus occur on the tubers. Disease causes cankers on the stems and aerial tubers on the plant. May reduce stand materially. (fungus)

Control: Rotate crops and treat seed with hot formalin or corrosive sublimate.

POTATO SPINDLE TUBER. Plants spindling and upright in growth. Tubers long and spindle shaped. (virus)

Control: Same as for mosaic. This disease may be transmitted by the cutting knife.

POTATO STORAGE ROTS. Much loss occurs from these troubles during storage. Several organisms are involved resulting in various symptoms which range from a very moist rot to a dry rot. Cottony growth of the causal fungus frequently occurs on the surface of the rotted areas. (fungus primarily)

Control: Exercise care in harvesting to prevent injury to tubers. Dry tubers as thoroughly as possible before placing in storage. Do not pile too deep. Provide good ventilation and keep temperature as nearly 40° F. as possible.

POTATO WITCHES BROOM. In this disease the plants are stunted and bushy with many branches and many small tubers formed both on long underground stems and in the branches above ground. Normally dormant buds grow almost as soon as formed, making a dense mass of growth below and above ground. (virus)

Control: Secure seed tubers free from this disease if possible. Remove diseased plants from seed fields as soon as symptoms appear.

RASPBERRY LEAF CURL. Leaves small, arched and wrinkled, margins curled inward. (virus)

Control: Secure disease-free plants. Remove and destroy any which may develop the disease.

RASPBERRY MOSAIC. Causes mottling of leaves and dwarfing of canes. May often cause destruction of entire planting. (virus)

Control: Same as for leaf curl.

RASPBERRY RUST. Large, bright, orange colored patches on leaves. Canes also sometimes affected. (fungus)

Control: All affected canes should be removed and burned at once.

ROSE BLACK SPOT. Small black spots appear on the upper surface of the rose leaves. These spots increase in size until the entire leaflet is affected. Leaves may be caused to fall as the result of the infection. (fungus)
Control: Use the same control measures as for powdery mildew of roses.

ROSE POWDERY MILDEW. The characteristic powdery mildew appears on leaves and branches causing a severe stunting of the growing tips. (fungus)

Control: Use resistant rose varieties when possible. Destroy all infected portions of the plant. Apply fine dusting sulphur as soon as the disease appears and every 10 days during the summer.

SILVER LEAF. This disease is common in certain cut-over areas of Idaho on shade as well as fruit trees. The leaves of the infected trees have a silvery sheen and purple tinted fungus growths appear on the branches and body of the tree, principally on dead or dying portions of the tree. (fungus)

Control: The fungus organism gains entrance through wounds and is more severe following winter injury. Remove all diseased wood. Treat pruning wounds with Bordeaux paste.

SNAPDRAGON RUST. Typical rusted spots appear on leaves and stems of diseased plants. Usually appear first on plants which have over wintered. (fungus)

Control: If snapdragon rust appears during the summer, all plants should be destroyed in the fall as the disease overwinters on living plants. Sulphur dust will reduce the damage from rust if applied frequently during the summer.

STRAWBERRY CRINKLE. The most characteristic symptoms of this disease is the fact that the entire plant is much dwarfed and the leaves are crinkled around the edges. A certain amount of yellowing through the foliage may also occur. (virus)

Control: Secure plants free from this disease if possible. Rogue out infected plants as soon as noted.

STRAWBERRY ROOT-ROT. There are a number of fungi which may cause a rotting of the roots of the strawberry plants. The most important of these is rhizoctonia. The most constant symptom for the root rot is a rotting of the roots and a decayed condition of the crown of the plant. (fungus)

Control: Secure healthy plants and use soil which has not grown strawberries previously. It is well to avoid the use of land where potatoes have been recently grown as there is some evidence that the rhizoctonia fungus from potato plants may attack strawberries. Certain varieties are more resistant to root rot than others.

SWEET PEA MOSAIC. This disease causes a mottling and streaking of the flowers and leaves. Plants are usually badly dwarfed. (virus)

Control: Infected plants should be removed as soon as they are noted. If aphids are present a contact insecticide such as nicotine sulphate should be applied.

SWEET PEA POWDERY MILDEW. Diseased plants have a typical powdery mildew appearance with a white powdery growth developing on the upper surfaces of leaves. (fungus)

Control: Fine dusting sulphur applied as soon as the disease begins to appear will effectively check powdery mildew.

TOMATO BLOSSOM END-ROT. As the name indicates the disease is characterized by a dry rot of the blossom end of the tomato fruit. (non-parasitic)

Control: Blossom end-rot has been definitely associated with lack of available moisture. Where plentiful irrigaton water is furnished the disease seldom occurrs. Under non-irrigated conditions, practices which will tend to increase the water holding capacity of the soil will help to prevent the disease.

TOMATO CURLY TOP or WESTERN YELLOW TOMATO BLIGHT. Leaves first turn purple and roll upward, then the whole plant turns yellow and finally dies. (virus)

Control: Caused by same virus as curly-top of sugar beets. Shading plants helps to control. Selection for resistance promising.

TULIP BREAKING. Tulips which have a variegated flower color are said to be broken. This is often accompanied by mottling of the stems and leaves. This is a definite disease caused by a virus and transmitted by aphids. (virus)

Control: Diseased plants should be removed and destroyed as the disease spreads rapidly from one plant to another when aphids are present.

TULIP WILD FIRE. Wild fire appears first as small spots on the leaves and blossoms of the tulips. These later coalesce and in a few days the entire plant may become involved. Black sclerotia of the fungus may be found on the bulbs. (fungus)

Control: All bulbs with sclerotia or rotted spots should be discarded. Old tops of tulip plants should be cleaned up and destroyed after the blooming season.

WATERMELON WILT. Rapid wilting of portions or all of watermelon vines is followed by death of the entire plant. (fungus)

Control: The fungus causing this disease over-winters in the soil. Crop rotation and resistant varieties are the most satisfactory methods of control.

WHEAT BUNT or STINKING SMUT. Black balls of smut with characteristic fish odor form in place of the kernels of wheat. (fungus)

Control: Copper carbonate dust treatment, 2 or 3 ounces to the bushel, formaldehyde, or bluestone treatment.

WHEAT LOOSE SMUT. This disease appears when heads come out of boot. Destroys the whole head, the powdery smut spores being blown away by the wind until the stalk is bare. (fungus)

Control: Not controlled by the ordinary methods of seed treatment. Hot water only satisfactory method known. Better

to secure clean seed. Seed treatment advised only for treating small lot of seed for seed plot. Write for directions.

WHEAT SNOW SCALD. As the name indicates this disease is definitely associated with heavy snow fall which persists late in the spring. When the ground is not frozen under the snow the fungus causing snow scald may destroy an otherwise perfect stand of wheat. When the snow melts the wheat plants will be found to be covered with white mold growth. Small black sclerotia, the resting stage of the fungus, soon form on the surface and within the tissue of the wheat plants. Death of the entire plant usually results. (fungus)

Control: It has been noted that early seeded wheat is more subject to injury by snow scald than wheat planted at later dates. Certain varieties of wheat are much more susceptible than others.

Preparation of Insecticides and Fungicides

BAIT TRAPS FOR CODLING MOTHS

The best means now known of ascertaining the activity of codling moths and of properly timing spray applications is by the use of bait traps well located in the orchard. One of these traps consists essentially of a small granite pan with an opening 6 inches in diameter and so prepared that it may be suspended in an apple tree. Moths are attracted to the pan by a bait ferment, in which they drown. Daily observations of the traps furnish the orchardist information enabling him to know definitely when moths of a certain brood begin emerging and when the peak of emergence occurs. Having this information he can intelligently plan when to make spray applications to the greatest advantage. The bait that has given the best results in Idaho is prepared by mixing together the following ingredients:

Dimalt (malt syrup if dimalt is not available)	½ pint
Water	5 quarts
Compressed yeast	¼ cake

Keep the bait in glass or poreclain containers before using. Allow it to set about a day before using in order to start fermentation. Prepare only sufficient bait at one time to refill the traps two or three times in order that only fresh bait may be used.

Traps should be placed near the tops of the trees and be in place in the spring a week before the time of the calyx spray. They may be suspended by a string run over a branch or by a special scaffold equipped with pulleys. Traps should be examined early each morning, the moths captured the night before removed, and the traps refilled with bait to within about an inch of the top. Many kinds of moths are caught in bait traps so the grower must be sure he can distinguish codling moths if he is to be certain of his information.

BORDEAUX MIXTURE

Bordeaux mixture is a liquid spray made by combining in proper proportions copper sulfate (blue vitrol or bluestone) and milk of lime. The most common formula is 6-6-50; that is, 6 pounds of copper sulfate, 6 pounds of lime, and 50 gallons of water. Other proportions are often used.

Directions for mixing: If stone lime is used, two stock

solutions must be prepared, one of lime and one of copper sulfate. Each should be made up at the rate of 1 pound to a gallon of solution. Carefully slake the lime with just enough water to prevent the formation of a dry powder. After the violent boiling is over, add a small amount of water. Work to a paste or cream and let cool; then dilute to contain one pound of lime to a gallon of solution. If hydrated lime is used, one-half more by weight is needed and the amount required for each sprayerful should be stirred into enough water to make a thin paste. Suspend copper sulfate in a small cheese cloth bag in the water until dissolved.

The copper sulfate and lime are now ready for mixing. First partly fill the sprayer with water and then add the lime through a strainer, either 6 gallons of the stock solution of stone lime or 9 pounds of hydrated lime to each 50 gallons of spray. Continue to fill the sprayer with water until it is about two-thirds full. With the agitator going, add 6 gallons of copper sulfate solution to each 50 gallons of spray. Then add water to make up the final volume.

CHEMICALLY TREATED BANDS

When codling moth larvæ reach maturity they search for dark protected places in which to pupate. It has been estimated that about 50 per cent to 75 per cent of the larvae leaving the apples eventually will make their way under chemically treated bands where they are killed by the chemical. The chemically treated band consists of a strip of corrugated paper 2 inches wide which has been thoroughly impregnated with technical or crude beta naphthol. Two methods of impregnating the bands are in use.

Hot-dipped bands. Mix lubricating oil having a paraffin base and a viscosity of 300 with beta naphthol in the proportions of 1½ pints and 1 pound respectively. Heat the mixture until all of the beta naphthol has gone into solution. Continue heating until a temperature of 265° to 279° F. is reached and maintain this temperature throughout the treating process. Immerse each roll of corrugated paper in a position so that the tubes are vertical and so that only half of the roll is in the solution. Allow the roll to remain approximately one second, then turn it over and immerse the other half. This complete process then may be repeated, producting a double dipped band.

Cold-dipped bands. A factory product of beta naphthol finely ground with oil in the correct proportions for dipping may be diluted with gasoline and the bands dipped in this

diluted material without heating. The proportions to use are 1 pound of beta naphthol, 1½ pints of 200-300 seconds viscosity oil, and 1 pint of gasoline.

Chemically treated bands 2 inches wide to be effective should contain at least 2 pounds of beta naphthol per 100 linear feet. Both oil and beta naphthol are inflamable but not explosive and beta naphthol is irritating to the eyes and skin. All work in connection with preparing chemically treated bands should be carried on out-of-doors.

CALCIUM ARSENITE AND SODIUM ARSENITE DUST

Mixing arsenical dusts for Mormon cricket control must be carefully and thoroughly done. Both sodium and calcium arsenite are very caustic and cause deep sores that are difficult to heal, as well as serious inflammation of the mucous membrane. These arsenicals should be mixed with the hydrated lime in tight containers. For small amounts the ingredients may be placed in a metal drum, the lid fitted tightly and the drum then rolled slowly back and forth on the ground until a complete mixture is obtained. When large amounts are to be used, it is practicable to do the mixing in a cement mixer equipped with a tight fitting cover. Mixing should be done out-of-doors where air currents will carry away the arsenical dust floating in the air.

DISINFECTANTS FOR VEGETABLE STORAGE BINS

Copper sulphate (Bluestone)	1 pound
Water	10 gallons
or	
Formaldehyde	1 pint
Water	10 gallons

Remove all decayed materials from cellars and bins and spray or swab the storage places with either of the above solutions. After having been disinfected the bins should be well aired and dried out before they are used.

LIME-SULPHUR

References to lime-sulphur in this bulletin are to commercial liquid lime-sulphur only, testing 32° Baume or higher. If home-prepared liquid lime-sulphur is used it should be diluted only by hydrometer test. Use enough of the concentrate so that the dilute spray in the tank tests 4° or 5° for San Jose scale or, for blister mite alone, 3½° Baume.

DILUTION TABLE FOR LIME-SULPHUR

Degrees Baume	Specific Gravity	Amount of lime-sulphur solution to be used in making up 100 gallons of diluted spray.			
		For dormant spraying		For summer spraying	
		gallons	pints	gallons	pints
20	1.1600	26	7	4	4
21	1.1693	25	1	4	4
22	1.1788	24	—	4	—
23	1.1885	22	6	3	6
24	1.1983	21	6	3	4
25	1.2083	20	—	3	2
26	1.2184	18	2	3	—
27	1.2288	17	1	2	6
28*	1.2393	16	2	2	4
29	1.2500	15	3	2	4
30	1.2608	14	6	2	2
31	1.2719	14	—	2	2
32	1.2831	13	1	2	—
33†	1.2946	12	5	2	—
34	1.3063	12	—	1	6
35	1.3181	11	3	1	6

*Approximate strength of lime-sulphur made by the 50-gallon formula.
†Standard commercial.

NOTE—Since the strengths of the solutions made according to the 50-100-50 formula and also of the commercial lime-sulphur are only approximately those indicated by the figures carrying notes (*) and (†) in column 1 above, it is suggested that the orchardist test his solution with a hydrometer, so that in making up 100 gallons of spray he can use exactly the number of gallons of lime-sulphur solution indicated in the table for a solution of that particular density.

If dry lime-sulphur is used, calculate the strength of the dilute solution on the basis of the chemical equivalent of the standard commercial liquid concentrate. The hydrometer test is not reliable in determining strength of solution of dry lime-sulphur. Five pounds of dissolved dry lime-sulphur is equivalent chemically to 1 gallon of 32° Baume liquid lime-sulphur.

Home-made Lime-sulphurs

For making the mixtures at home the following formula is in common use:

50-gallon formula:
Ground sulphur ..... 100 pounds
Lump lime ..... 50 pounds
Water ..... 50 gallons

Lime-sulphur is prepared by cooking the ingredients together until practically all the free sulphur has dissolved, a process which requires approximately 45 minutes. When the spray is made in large quantities, the cooking is usually done with live steam. With smaller quantities it is more often done in kettles over a fire.

OIL SPRAYS

Home-prepared emulsions. Oil emulsions may be prepared at home. With proper precautions taken in preparation and use they are safe, effective, and less expensive than commercial emulsions. Stock emulsions containing the percentages of oils indicated are prepared from the following materials:

	Amount of emulsion		
Ingredients	134 gallons	10 gallons	1 gallon
Water	34 gallons	2.5 gallons	2 pints
Ammonia (28%, concent.)	1 quart	2.4 fluid oz.	2 tspnfl.
Finely powdered casein	3 pounds	3.6 ounces	½ ounce
Oil	100 gallons	7.5 gallons	6 pints

When preparing the larger amounts of emulsion, put the water into the spray tank, add the amonia, and, with the pump running, sift the casein in slowly. As soon as the casein is dissolved add the oil about as fast as it will run from the drum. Be sure to let the oil run in slowly until the agitator is well covered, else a reversed emulsion may result. (A reversed emulsion will not mix with water and cannot be used). Allow the mixture to be thoroughly stirred by the agitator for a few minutes and then pump it through a spray hose at about 250 pounds pressure into empty drums for storage. A second pumping is advisable if the emulsion is to be kept longer than a few days.

The smaller amounts are prepared by following the same procedure as outlined above but they are pumped through the pump of a barrel sprayer or through the pump of a bucket sprayer until a uniform, creamy emulsion results. One-gallon lots of emulsion are readily prepared by the use of kitchen electric mixers. Be very careful to add the materials in the order specified.

When preparing oil emulsions by the "tank-mix" method, the amount of oil required for a tank of spray is emulsified each time the tank is filled. If 1 per cent of oil is to be used, 1 gallon of oil is emulsified or mixed in each 99 gallons of water. Procedure: First, fill the tank with water to cover the agitator and, with agitator running, add the emulsifier.

It is best to mix the emulsifier with a little water before adding it to the tank. Next, slowly pour the required amount of oil into the tank and then fill with water with the agitator running. Apply the tank-mixed spray immediately, continuing agitation until the tank is empty. A satisfactory emulsifier is a blood albumin-Fuller's earth mixture which can be purchased on the market in convenient sized packages. It is used at the rate of 4 ounces to 100 gallons of spray. The "tank-mix" method should be used only with tanks having high speed agitators or equipped with square-end agitator paddles, since a thorough agitation is necessary for a good emulsion or mixture. When lead arsenate is used, add it after the tank is filled.

Commercial Oil Emulsions. Many high grade commercial oil emulsions are on the market. Most of these contain approximately 80 per cent oil and 20 per cent water and emulsifying material. An oil emulsion is simply oil that has been mechanically broken up into tiny globules which are coated with emulsifier that prevents the globules from running together. These small coated globules are then held in suspension in the water until sprayed out and the effect thus is to dilute oil with water so that free oil, which is injurious, is not sprayed on living plants. The two general types of oil emulsions are designated in this bulletin roughly as dormant-type and summer-type. Dormant-type emulsions are prepared from lower grade oils than summer-type and are therefore cheaper. They may cause severe injury if sprayed on green foliage.

Calculating oil Spray Dilutions. To determine the number of gallons of stock emulsion to use, multiply the number of gallons of dilute spray to be made by the percentage of oil desired in the dilute spray and divide the product by the percentage of oil in the stock emulsion. For example, suppose it is desired to prepare 200 gallons of dilute spray containing 3 per cent oil from a stock emulsion containing 80 per cent oil:

$$\frac{200 \times 3}{80} = 7.5\ (7\tfrac{1}{2})\ \text{gallons of stock emulsion.}$$

Precautions with Oil Sprays. Follow directions carefully. If the amount of oil is increased in proportion to the amount of water a reversed emulsion is almost sure to occur. A reversed emulsion will not mix with water and is worthless. When through preparing the stock emulsion, each time the tank is

filled, pump dilute solution through the hoses until all of the stock emulsion is cleaned out, otherwise severe damage will be done to the first tree or two sprayed. When stock emulsion is prepared in advance, stir it each time before using.

SPECIFICATIONS OF SPRAY OILS: *Dormant-type oil.* The oils recommended for dormant spraying are designated as close-cut mineral oils having a viscosity of from 100 to 120 seconds at 100° F. and a sulphonation test of from 50 to 70. *Summer type oil.* These mineral oils are labeled "Light," "Light Medium," and "Medium." They have viscosities as noted below and should come within the following distillation range specifications:

Light:	Viscosity at 100° F.	52 seconds
	65-100% of oil should distil at	**636° F.**
	Not more than 10% should distil at	520° F.
	Not less than 80% should distil at	**665° F.**
Light-Medium:	Viscosity at 100° F.	**63 seconds**
	50-65% of oil should distil at	636° F.
	Not more than 10 % should distil at	530° F.
	Not less than 80% should distil at	**715° F.**
Medium:	Viscosity at 100° F.	**75 seconds**
	40-49% of oil should distil at	636° F.
	Not more than 10% should distil at	540° F.
	Not less than 80% should distil at	725° F.

POISONED BRAN BAIT

Poisoned bran bait may be prepared from either of the two following formulae:

Formula I

	Large Amount	Small Amount
Coarse bran, free from shorts	100 pounds	10 pounds
Liquid sodium arsenite, 4-pound material	2 quarts	52 teaspoonfuls
Water	6 to 8 gallons	3 quarts
Molasses	2 gallons	1½ pints
Amyl acetate, technical grade	3 ounces	2 teaspoonfuls

Formula II

Coarse bran, free from shorts	100 pounds	10 pounds
White arsenic or Paris green	6 pounds	9½ ounces
Water	6 to 8 gallons	3 quarts
Molasses	2 gallons	3 quarts
Amyl acetate, technical grade	3 ounces	2 teaspoonfuls

The bait may be mixed on a cement or wooden floor, in a tight wagon box, on a canvas, etc. The bran should be spread out thinly and the liquid added very slowly while the whole mass is being mixed. Mixing should be done very thoroughly. If *Formula I* is used the molasses, sodium arsenite and amyl

acetate are mixed thoroughly with part of the water, then the liquid mixture, and finally the remainder of the water, are added slowly to the bran as it is being mixed with a shovel or hoe. After the necessary water has been added, reshovel the bait until it is very uniformly mixed. If *Formula II* is used, the powdered white arsenic or Paris green is first thoroughly mixed with the bran. The amyl acetate and molasses are mixed with the water and the same procedure is followed as in *Formula I*. The bran mash should be just moist enough so that when pressed in the hand it will not become lumped and when broadcast it will break up into flakes.

Formula I is to be preferred because the liquid sodium arsenite is much more easily mixed into the bait and is less irritating to persons preparing the bait than the dry form of poison.

PREPARATION OF NICOTINE DUST

Prepared nicotine dusts are stocked by some of the insecticide dealers. Nicotine dusts deteriorate rapidly. Be sure to obtain fresh stock in unbroken packages.

Nicotine dust may be prepared fresh as needed and the home-prepared is cheaper than the factory-prepared product. Procure a 10-gallon keg with both heads intact. Mount the keg on standards like a barrel churn but with the pivots in the center of the heads. Allow one pivot to protrude beyond the standard and to this fasten a crank. Cut a hole in the center of the side of the keg through which to put in and take out materials. Over the opening, hinge a lid which is held tightly in place by a clasp. Nicotine dust is made by adding nicotine sulphate containing 40 per cent nicotine to hydrated lime and mixing them thoroughly together. To make 10 pounds of nicotine dust containing a certain percentage of nicotine, multiply the number of pounds of lime by the percentage of dust required and divide the product by 0.4. The result will be the amount of 40 per cent nicotine sulphate in pints to use. For example, suppose it is desired to make 10 pounds of 3 per cent nicotine dust:

$$10 \times .03 \div 0.4 = 0.75 \ (\tfrac{3}{4}) \text{ pint nicotine sulphate}$$

In mixing, place the hydrated lime in the keg, pour the nicotine sulphate over it, close the lid and rotate the mixer slowly for about 5 minutes. When placing the materials in the keg, include about 5 pounds of smooth rocks about 2 inches in diameter which help make a better mixture. Empty out the

finished dust through a screen to remove the rocks and store the dust immediately in tight containers. A better type of dust may be prepared by using 2 pounds of monohydrated copper sulphate and 8 pounds of hydrated lime instead of 10 pounds of hydrated lime.

WETTABLE GROUND SULPHURS

Pure sulphur, however finely ground, is not wettable; the addition of certain wetting agents is necessary before it can be used in liquid sprays. A number of commercial brands of wettable sulphur are now on the market. In purchasing wettable sulphurs, the grower should consider five points: (1) percentage of sulphur; (2) price; (3) fineness of particles; (4) rate of settling; (5) convenience of mixing.

A material having less total sulphur is not necessarily inferior, provided the price is correspondingly low and the recommendations call for equivalent amounts of sulphur. The ground wettable sulphurs are not so toxic to fungi as is lime-sulphur but they are safer to use on plants subject to lime-sulphur injury.

Wettable sulphur may be prepared also according to the following formula. For each 100 gallons of dilute spray use:

Fine sulphur	16 pounds
Casein spreader	1 pound

Sift the sulphur through a screen (12 to 14 meshes to the inch will be satisfactory) to break up all lumps. Mix the sulphur and casein spreader in the dry form until of uniform color throughout. For small quantities this may be done in any convenient container but for large quantities a mechanical mixer of some sort is very desirable.

This mixture may be made up in advance if desired. Twenty-five pounds of the stock preparation should be used for each 100 gallons of spray.

Dilution and mixing may be accomplished in any one of several ways:

1. Place the proper amount of stock mixture in a barrel or other tight container. Add water slowly, stirring thoroughly until the mixture is wet and in the form of a thin paste which will pass readily through the sprayer strainer. The mixing may be done with a paddle or hoe, or a very easy way is to use a spray gun, turning the water from the sprayer into the mixture. This adds the necessary water and mixes at the same time. Strain into sprayer tank, which should be

nearly full of water and with the agitator running to insure thorough mixing and to prevent settling.

2. With agitator running pour the proper amount of dry-mix into the spray tank, which is nearly full of water. Turn the nozzle or spray gun directly into the mixture as it falls on the water in the tank. Thorough agitation is very necessary and the agitator should be kept running from the time the mixture is added to the tank until it is all sprayed out. Lead arsenate may be added to this if desired.

WHITEWASH

An exceptionally durable whitewash may be prepared by the following formula.

Hydrated lime	5 pounds
or	
Stone lime	3 pounds, 13 ounces
Sodium phosphate	10 ounces
Powdered casein	1 pound
Water	2 gallons

Stir the water into the lime, dissolve the casein in the solution of sodium phosphate, and mix with the lime water. Two gallons of skimmed milk may be substituted for the casein in the formula. When whitewash is to be applied with a spray machine it should be thinned with water and passed through a 20-mesh screen into the spray tank. When applied with a brush, it should not be brushed in like an oil paint but spread lightly over the surface. If stone lime is used, slake it first with a small amount of water, after which add the remainder of the liquid.

EQUIVALENTS OF MEASURE

For preparing small amounts of spray mixtures:

1 pound equals 16 ounces
1 pint equals 128 teaspoonfuls
1 fluid ounce equals 1/16 pint or 8 teaspoonfuls
1 bushel equals 2150.42 cubic inches or 1.24 cubic feet
1 ounce equals 28.35 grams
1 to 400 dilution equals 2½ teaspoonfuls to 1 gallon

LIST OF INSECTS, PLANT DISEASES AND CAUSAL ORGANISMS

Alfalfa bacterial wilt
Aplanobacter insidiosum McC.

Alfalfa crown and stem rot
Sclerotinia trifoliorum Eriks.

Alfalfa crown wart
Urophlyctis alfalfae (Lagh.) Magn.

Alfalfa downy mildew
Peronospora trifoliorum D By.

Alfalfa leaf blotch
Pyrenopeziza medicaginis Fckl.

Alfalfa leaf spot
Pseudopeziza medicaginis (Lib.) Sacc.

Alfalfa looper
Autographa californica Speyer

Alfalfa stem blight
Pseudomonas medicaginis Sack.

Alfalfa webworm
Loxostege commixtalis Wlk.

Alfalfa weevil
Hypera postica Gyll.

Angoumois grain moth
Sitotroga cerealella Oliv.

Apple aphid
Aphis pomi DeG.

Apple blue mold
Penicillium expansum Lk.

Apple leafhopper
Empoasca maligna Walsh

Apple perennial canker
Gloeosporium perennans Z. & C.

Apple powdery mildew
Podosphaera leucotricha (E. & E.) Salm.

Apple scab
Venturia inaequalis (Cke.) Wint.

Apricot-peach blight
Coryneum beijerinckii Oud.

Aster wilt
Fusarium conglutinans callistephi Beach

Bark beetles
Dendroctonus brevicomis Lec.
Dendroctonus monticolae Hopk.

Barley covered smut
Ustilago hordii (Pers.) Kell. & Sw.

Barley leaf rust
Puccinia simplex (Koern.) E. & H.

Barley loose smuts
Ustilago nigra Tapke
Ustilago nuda (Jens.) Kell. & Sw.

Barley stem rusts
Puccinia graminis tritici E. & H.
Puccinia graminis secalis E. & H.

Barley stripe
Ploespora graminicum Died.

Barley stripe rust
Puccinia glumarum Erik.

Bean anthracnose
Colletotrichum lindemuthianum (Sacc. & Magn.) B. & C.

Bean bacterial blight
Bacterium phaseoli EFS.

Bean dry root rot
Fusarium spp.

Bedbug
Cimex lectularius L.

Beet leafhopper
Eutettix tenellus Bak.

Beet webworm
Loxostege sticticalis L.

Black cherry aphid
Myzus cerasi Fab.

Black peach aphid
Anuraphis persicae-niger Smith

Black vine weevil
Brachyrhinus sulcatus Fab.

Blister beetles
Epicauta maculata Say
Lytta nuttalli Say
Macrobasis unicolor Kby.

Boxelder bug
Leptocoris trivittatus Say

Bulb mite
Rhizoglyphus hyacinthi Bdv.

Cabbage aphid
Brevicoryne brassicae L.

Cabbage maggot
Hylemyia brassicae Bouche

Carpenter worm
Prionoxystus robiniae Peck

Carpet beetle
Anthrenus scrophulariae L.

Celery late blight
Septoria apii Rostr.

Cherry fruit fly
Rhagoletis cingulata Loew

Cherry powdery mildew
Podosphaera oxyacanthae (Fr.) D By.

Chrysanthemum gall midge
Diarthronomyia hypogaea Loew

Clothes moths (webbing)
Tineola biselliella Hum.

Clover aphid
Anuraphis bakeri Cowan

Clover leaf weevil
Hypera punctata Fab.

Clover mite
Bryobia pretiosa Koch

Clover nematode
Tylenchus dipsaci (Kuhn) Bast.

Clover powdery mildew
Erysiphe polygoni DC.

Clover root borer
Hylastinus obscurus Marsham

Clover root curculio
Sitona hispidula Fab.

Clover rusts
Uromyces spp.

Clover seed caterpillar
Grapholitha conversana Wlsm.

Clover seed chalcid
Bruchophagus funebris How.

Clover seed midge
Dasyneura leguminicola Lint.

Cockroaches
Blatella germanica (L.)
Blatta orientalis L.

Codling moth
Carpocapsa pomonella L.

Colorado potato beetle
Leptinotarsa decemlineata Say

Corn ear worm
Heliothis obsoleta Fab.

Corn smut (common)
Ustilago zeae (Beckm.) Ung.

Corn smut (head)
Sorosporium reilianum (Kuhn) McA.

Cottony maple scale
Pulvinaria vitis L.

Crown gall
Bacterium tumefaciens EFS. & Town.

Currant aphid
Myzus ribis L.

Cutworms (many species
Agrotis c-nigrum L.
Agrotis ypsilon Rott.
Chorizagrotis auxilaris Grt.
Lycophotia margaritosa Hbn.
Ufeus hulsti Sm.

Damping off
Pythium sp.

Delphinium powdery mildew
Erysiphe polygoni DC.

Diamond-back moth
Plutella maculipennis Curt.

Elm-leaf beetle
Galerucella xanthomelaena Schr.

Ergot
Claviceps purpurea (Fr.) Tul.

European earwig
Forficula auricularia L.

European elm scale
Gossyparia spuria Mod.

European red mite
Paratetranychus pilosus C. & F.

Eye-spotted bud moth
Spilonota ocellana Schiff.

Fall webworm
Hyphantria cunea Drury

False chinch bug
Nysius ericae Schill.

False wireworms
Eleodes extricata Say
Eleodes hispilabris Say

Fire blight
Bacterium tumefaciens EFS. & Town.

Firebrat
Thermobia domestica Pack.

Forest tent caterpillar
Malacosoma disstria Hbn.

Four-spotted tree cricket
Oecanthus nigricornis quadripunctatus Bent.

Fruit tree leaf roller
Cacoccia argyrospila Walk.

Gladiolus hard rot
Septoria gladioli Pass.

Gladiolus scab
Bacterium marginatum McC.

Gooseberry fruit worm
Zophodia grossulariae Riley

Gooseberry powdery mildew
Sphaerotheca mors-uvae (Schw.) Berk. & Curt.

Granary weevil
Sitophilus granaria L.

Grape leafhopper
Erythroneura comes Say

Grasshoppers (Several species)
Camnula pellucida Scudd.
Melanoplus bivitattus Say
Melanoplus mexicanus Saussure

Greenhouse leaf tier
Phlyctaenia rubigalis Guen.

Greenhouse whitefly
Trialeurodes vaporariorum Westw.

Green peach aphid
Myzus persicae Sulz.

Hairy root
Phytomonas rhizogenes Riker et al.

(Hollyhock) beetle
Calligrapha sigmoidea (Lec.)

Hollyhock rust
Puccinia malvacearum C.G. Bertero

Hop looper
Hypena humuli Harr.

Housefly
Musca domestica L.

Imported cabbage worm
Ascia rapae L.

Imported currant worm
Pteronidea ribesii Scop.

Iris leaf spot
Didymellina macrospora Kleb.

Iris soft rot
Bacillus carotovorus L.R. Jones

Larder beetle
Dermestes lardarius L.

Leaf-curl plum aphid
Anuraphis helichrysi Kalt.

Legume bugs
Lygus elisus Van D.
Lygus hesperus Kngt.

Mealy plum aphid
Hylopterus arundinis Fab.

Mediterranean flour moth
Ephestia kuehniella Zell.

Mineola moth
Mineola scitulella Hulst

Mormon cricket
Anabrus simplex Hald.

Mourning-cloak butterfly
Hymadryas antiopa L.

Mushroom root rot
Armillaria mellea (Vahl.) Fr.

Oat crown rust
Puccinia coronata Corda

Oat stem rust
Puccinia graminis avenae E. & H.

Oat smuts
Ustilago avenae (Pers.) Jens.
Ustilago levis (Kell. & Swin.) Magn.

Onion maggot
Hylemyia antiqua Meig.

Onion neck rot
Botrytis allii M. T. Munn

Onion smut
Urocystis cepulae C. C. Frost

Onion thrips
Thrips tabaci Lind.

Oyster-shell scale
Lepidosaphes ulmi L.

Pansy powdery mildew
Sphaerotheca humuli fuliginea (Schl.) Salm.

Pea aphid
Illinoia pisi Kalt.

Pea bacterial blight
Bacterium pisi (Sack.) **EFS.**

Pea weevil
Bruchus pisorum **L.**

Pea wilt
Fusarium orthoceras pisi (App. & Wr.) **Lin.**

Pea powdery mildew
Erysiphe polygoni **DC.**

Pea root rots
Aphanomyces euteiches **Drechs.**
Fusarium martii pisi **F. R. Jones**

Peach blight
Coryneum beijerinckii **Oud.**

Peach borer
Aegeria exitiosa **Say**

Peach leaf curl
Exoascus deformans (Berk.) **Fckl.**

Peach twig borer
Anarsia lineatella **Zell.**

Pear leaf blister mite
Eriophes pyri **Pgst.**

Pear slug
Eriocampoides limacina **Retz.**

Pine needle scale
Chionaspis pinifoliae **Fitch**

Potato black leg
Bacillus carotovorus **L. R. Jones**

Potato wilt
Fusarium spp.

Potato Rhizoctonia
Corticium vagum **Berk. & Curt.**

Potato scab
Actinomyces scabies (Thax.) **Gus.**

Potato storage rots
Fusarium spp.

(Prune) leafhopper
Typhlocyba pomaria **McA.**

Raspberry root borer
Bembecia marginata **Harr.**

Raspberry rust
Gymnoconia interstitialis (Schl.) **Lagh.**

Red spider, common
Tetranychus telarius **L.**

Rose aphid
Macrosiphum rosae **L.**

Rose black spot
Diplocarpon rosae **Wolf.**

Rose curculio
Rhynchites bicolor **Fab.**

Rose powdery mildew
Sphaerotheca pannosa (Wallr.) **Lev.**

Rose scale
Aulacaspis rosae **Bouche**

Rosy apple aphid
Anuraphis roseus **Baker**

San Jose scale
Aspidiotus perniciosus **Comst.**

Saw-toothed grain beetle
Oryzaephilus surinamensis **L.**

Seedcorn maggot
Hylemyia cilicrura **Meig.**

Silver leaf
Stereum purpureum **Pers.**

Snapdragon rust
Puccinia antirrhini **Diet. & Holw.**

Snowball aphid
Aphis viburnicola **Gill.**

Snow scald
Typhula graminum **Karst.**

Snowy tree cricket
Oecanthus niveus **DeG.**

Spruce gall aphid
Adelges cooleyi **Gill.**

Squash bug
Anasa tristis **DeG.**

Strawberry crown moth
Aegeria rutilans **Hy. Edw.**

Strawberry leaf roller
Ancylis comptana **Froel.**

Strawberry root rot
Rhizoctonia soloni **Kuhn**

Strawberry root weevil
Brachyrhinus ovatus **L.**

Sweet pea powdery mildew
Erysiphe polygoni **DC.**

Termites
Reticulitermes hesperus **Banks**

Thistle aphid
Anuraphis cardui **L.**

Tomato psyllid
Paratrioza cockerelli **Sulc.**

Tomato worm
Phlegethontius quinquemaculata **Haw.**

Tree hoppers
Cercsa basalis **Walk.**
Ceresa stimulea **(Van D.)**
Heliria rubidella **(Ball)**
Stictocephala wickhami **Fab.**

Tulip wildfire
Botrytis tulipae (Lib.) **Hopk.**

(Virginia creeper) leafhopper
Erythroneura ziczac **Walsh**

Watermelon wilt
Fusarium nivcum **EFS.**

Western black flea beetle
Phyllotreta pusilla **Horn**

Western potato flea beetle
Epitrix subcrinata **Lec.**

Wheat bunt
Tilletia laevis **Kuhn**
Tilletia tritici (Bjerk.) **Wint.**

Wheat leaf rust
Puccinia triticina **Erik.**

Wheat loose smut
Ustilago tritici (Pers.) **Rostr.**

Wheat stem rust
Puccinia graminis tritici **E. & H.**

Wheat stripe rust
Puccinia glumarum **Erik.**

White apple leaf hopper
Typhlocyba pomaria **McA.**

White grubs (many species)
Polyphylla decemlineata **Say**
Ligyrus gibbosus **DeG.**

White-lined sphinx
Sphinx lineata **L.**

Wireworms
Ludius inflatus **Say**
Limonius (Pheletes) californicus **Mann.**
Limonius (Pheletes) canus **(Lec.)**

Woolly apple aphid
Eriosoma lanigera **Hausm.**

Zebra caterpillar
Mamestra picta **Harr.**

INDEX

Page

ALFALFA
- Alfalfa looper ... 3
- Alfalfa webworm ... 7
- Alfalfa weevil ... 3
- Bacterial wilt ... 51
- Beet webworm ... 7
- Blister beetle ... 9
- Clover leaf weevil ... 14
- Clover root curculio ... 15
- Clover seed chalcid ... 15
- Crown and stem rot ... 50
- Crown wart ... 50
- Cutworms ... 19
- Downy mildew ... 50
- Grasshoppers ... 25
- Leaf blotch ... 50
- Leaf spot ... 50
- Legume bugs ... 30
- Mormon cricket ... 31
- Pea aphid ... 34
- Red spider ... 38
- Stem blight ... 50
- Tree hoppers ... 46
- White lined sphynx ... 48
- White spot ... 50

APPLE
- Ants ... 4
- Apple aphid ... 5
- Apple leafhopper ... 5
- Blue mold ... 51
- Chlorosis ... 55
- Cicadas ... 12
- Clover mite ... 14
- Codling moth ... 16
- Crown gall ... 56
- Drought spot ... 51
- European red mite ... 20
- Eye-spotted bud moth ... 21
- Fall webworm ... 21
- Fire blight ... 58
- Forest tent caterpillar ... 23
- Fruit tree leaf roller ... 23
- Hairy root ... 59
- Mineola moth ... 31
- Mushroom root rot ... 60
- Oyster-shell scale ... 34
- Pear leaf blister mite ... 36
- Perennial canker ... 52
- Powdery mildew ... 52
- Red spider ... 38
- Rosette ... 53
- Rosy apple aphid ... 39
- San Jose scale ... 40
- Scab ... 52
- Scald ... 52
- Silver leaf ... 64
- Soft scald ... 52
- Tree hoppers ... 46
- Water core ... 51
- Woolly apple aphid ... 49

APRICOT
- Chlorosis ... 55
- Crown gall ... 56
- European red mite ... 20
- Hairy root ... 59
- Mineola moth ... 31
- Mushroom root rot ... 60
- Peach blight ... 61
- Peach borer ... 35
- Peach twig borer ... 36
- Red spider ... 38

Page

APRICOT (cont.)
- San Jose scale ... 40
- Silver leaf ... 64
- Stone flies ... 43
- Tree hoppers ... 46

ASTER
- Wilt ... 53
- Yellows ... 53

BAIT TRAPS FOR CODLING MOTH ... 68

BARLEY
- Covered smut ... 53
- Ergot ... 58
- Leaf rust ... 59
- Loose smut ... 53
- Stem rust ... 59
- Stripe ... 54
- Stripe rust ... 59

BEANS
- Anthracnose ... 54
- Bacterial blight ... 54
- Baldhead ... 54
- Beet leafhopper ... 6
- Blister beetles ... 9
- Curly top ... 57
- Cutworms ... 19
- Dry root rot ... 54
- False chinch bug ... 21
- Grasshoppers ... 25
- Legume bugs ... 30
- Mosaic ... 54
- Red spider ... 38
- Seedcorn maggot ... 41
- Wireworms ... 48

BEETS
- Beet leafhopper ... 6
- Beet webworm ... 7
- Blister beetles ... 9
- Crown gall ... 56
- Curly top ... 57
- Cutworms ... 19
- Damping off ... 57
- False chinch bug ... 21
- White grubs ... 47
- Wireworms ... 48

BORDEAUX MIXTURE ... 68

BOXELDER
- Boxelder bug ... 9

BULBS
- Bulb mite ... 9

CABBAGE AND RELATED VEGETABLES
- Cabbage aphid ... 10
- Cabbage maggot ... 10
- Cabbage worm ... 10
- Cutworms ... 19
- Diamond-back moth ... 19
- Grasshoppers ... 25
- Western black flea beetle ... 47
- Wireworms ... 48

CALCIUM ARSENITE DUST ... 70

CELERY
- Late blight ... 55
- Zebra caterpillar ... 49

CHEMICALLY TREATED BANDS..... 69

CHERRY
Black cherry aphid 8
Cherry fruit fly 12
Chlorosis 55
Clover mite 14
Crown gall 56
European red mite 20
Hairy root 59
Mineola moth 31
Mushroom root rot 60
Peach twig borer 36
Pear slug 37
Powdery mildew 55
Red spider 38
San Jose scale 40
Silver leaf 64
Tree hoppers 46

CHLOROSIS 55

CHRYSANTHEMUM
Chrysanthemum gall midge 12
Grasshoppers 25
Lace bugs 28
Red spider 38

CLOVER
Alfalfa looper 3
Beet webworm 7
Clover aphid 13
Clover leaf weevil 14
Clover mite 14
Clover root borer 15
Clover root curculio 15
Clover seed caterpillar 15
Clover seed chalcid 15
Clover seed midge 15
Cutworms 19
Grasshoppers 25
Legume bugs 30
Nematode 14, 55
Powdery mildew 56
Red spider 38
Rust 56
Tree hoppers 46

CONIFEROUS TREES AND SHRUBS
Bark beetles 6
Pine needle scale 37
Red spider 38
Spruce gall aphid 42

CORN
Alfalfa looper 3
Common smut 56
Corn ear worm 18
Cutworms 19
False chinch bug 21
Grasshoppers 25
Head smut 56
Seedcorn maggot 41
White grubs 47
Wireworms 48

CROWN GALL 56

CURLY TOP 57

CURRANT
Currant aphid 18
Gooseberry fruit worm 24
Imported currant worm 18
Red spider 38

DAHLIA
Mosaic 57

Page
DAMPING OFF 57

DELPHINIUM
Black vine weevil 8
Powdery mildew 57
Witches broom 58

DISINFECTANTS, STORAGE BINS ... 70

ELM
Carpenter worm 11
Elm leaf beetle 19
European elm scale 20
Mourning-cloak butterfly 32
Red spider 38
Woolly apple aphid 49

ERGOT 58

FIELD AND FORAGE CROPS
Cutworms 19
Grasshoppers 25
Mormon cricket 31
Wireworms 48

FIREBLIGHT 58

GLADIOLUS
Hard rot 58
Scab 58

GOOSEBERRY
Chlorosis 55
Crown gall 56
Currant aphid 18
Gooseberry fruit worm 24
Hairy root 59
Mushroom root rot 60
Powdery mildew 59
Red spider 38
San Jose scale 40

GRAPE
Chlorosis 55
Cottony maple scale 18
Crown gall 56
Cutworms (climbing) 19
Four-spotted tree cricket 23
Grape leafhopper 24
Grasshoppers 25
Hairy root 59
Mushroom root rot 60
Red spider 38
San Jose scale 40
Virginia creeper leafhopper 46

GREENHOUSE PESTS
Ants 4
Centipedes 11
Garden slug 24
Greenhouse leaf tyer 26
Greenhouse thrips 26
Greenhouse white fly 26
Mealybugs 30
Nematodes 32
Sowbugs 42

HAIRY ROOT 59

HOLLYHOCK
Hollyhock aphid 27
Hollyhock beetle 27
Rust 59

HOPS
Hop looper 27
Red spider 38

Page

HOUSEHOLD AND STORAGE INSECTS
- Ants ... 4
- Bedbug ... 6
- Boxelder bug ... 9
- Carpet beetle ... 11
- Clothes moth ... 13
- Cockroaches ... 16
- European earwig ... 20
- Firebrat ... 22
- Granary weevil ... 24
- House fly ... 28
- Larder beetle ... 28
- Mediterranean flour moth ... 31
- Saw-toothed grain beetle ... 40
- Termites ... 44

IRIS
- Leaf spot ... 59
- Soft rot ... 60

LETTUCE
- Alfalfa looper ... 3
- Cutworms ... 19
- Grasshoppers ... 25
- Tip burn ... 60
- Wireworms ... 48

LILAC
- Leaf cutter bees ... 29

LIME-SULPHUR ... 70

MAPLE
- Cottony maple scale ... 18

MOUNTAIN ASH
- Blister mite ... 36
- Oystershell scale ... 34

NICOTINE DUST ... 75

OATS
- Crown rust ... 59
- Ergot ... 58
- Smut ... 60
- Stem rust ... 59

OIL SPRAYS ... 72

ONION
- Cutworms ... 19
- Grasshoppers ... 25
- Neck rot ... 60
- Onion maggot ... 33
- Onion thrips ... 33
- Smut ... 60
- Webworms ... 7
- Wireworms ... 48

PANSY
- Powdery mildew ... 61

PEA
- Bacterial blight ... 61
- Cutworms ... 19
- Fusarium wilt ... 61
- Pea aphid ... 34
- Pea weevil ... 35
- Powdery mildew ... 61
- Red spider ... 38
- Root rot ... 61
- Wireworms ... 48

PEACH
- Black peach aphid ... 8

Page

PEACH (cont.)
- Blight ... 61
- Chlorosis ... 55
- Clover mite ... 14
- Crown gall ... 56
- European red mite ... 20
- Eye-spotted bud moth ... 21
- Green peach aphid ... 27
- Hairy root ... 59
- Leaf curl ... 62
- Mushroom root rot ... 60
- Peach borer ... 35
- Peach lecanium ... 36
- Peach twig borer ... 36
- Red spider ... 38
- San Jose scale ... 40
- Silver leaf ... 64
- Stone flies ... 43
- Tree hoppers ... 46

PEAR
- Apple aphid ... 5
- Chlorosis ... 55
- Codling moth ... 16
- Crown gall ... 56
- European red mite ... 20
- Fire blight ... 58
- Fruit tree leaf roller ... 23
- Hairy root ... 59
- Leaf cutter bees ... 29
- Mushroom root rot ... 60
- Pear leaf blister mite ... 36
- Pear slug ... 37
- Red spider ... 38
- San Jose scale ... 40
- Silver leaf ... 64
- Tree hoppers ... 46

PHLOX
- Red spider ... 38

PINE, See coniferous trees

PLUM, See prune

POISONED BRAN BAIT ... 74

POTATO
- Blackleg ... 62
- Blister beetles ... 9
- Calico ... 62
- Colorado potato beetle ... 17
- False chinch bug ... 21
- Fusarium wilt ... 62
- Leaf roll ... 62
- Legume bugs ... 30
- Mosaic ... 62
- Red spider ... 38
- Rhizoctonia ... 63
- Scab ... 62
- Seedcorn maggot ... 41
- Spindle tuber ... 63
- Storage rots ... 63
- Tomato psyllid ... 45
- Western potato flea beetle ... 47
- White grubs ... 47
- Wireworms ... 48
- Witches broom ... 63

PRUNE
- Leaf-curl plum aphid ... 29
- Leafhopper ... 5
- Mealy plum aphid ... 30
- Mineola moth ... 31
- Peach borer ... 35
- Peach twig borer ... 36
- Red spider ... 38
- San Jose scale ... 40

Page

PRUNE (cont.)
Snowy tree cricket 42
Thistle aphid 45
Tree hoppers 46

RADISH, See cabbage

RASPBERRY
Chlorosis 55
Clover mite 14
Crown gall 56
False chinch bug 21
Four-spotted tree cricket 23
Grasshoppers 25
Hairy root 59
Leaf curl 63
Legume bugs 30
Mushroom root rot 60
Mosaic 64
Raspberry root borer 37
Red spider 38
Rust 64
San Jose scale 40
Snowy tree cricket 42

ROSE
Black spot 64
Chlorosis 55
Crown gall 56
Hairy root 59
Leaf cutter bees 29
Mushroom root rot 60
Powdery mildew 64
Red spider 38
Rose aphid 39
Rose curculio 39
Rose leafhopper 39
Rose scale 39
San Jose scale 40

SILVER LEAF 64

SNAPDRAGON
Rust 64

SNOWBALL
Snowball aphid 41

SODIUM ARSENITE DUST 70

SPRUCE, See coniferous trees

SQUASH
Curly top 57
Cutworms 19
Squashbug 43

STORAGE INSECTS, See household insects

STRAWBERRY
Ants 4
Black vine weevil 8
Chlorosis 55
Crinkle 65
Cutworms 19
False chinch bug 21
Garden slug 24
Grasshoppers 25
Leather jackets 29
Legume bugs 30
Red spider 38
Root rot 65
Strawberry crown moth 43
Strawberry leaf roller 44
Strawberry root weevil 44
White grubs 47
Wireworms 48

Page

SWEET PEA
Grasshoppers 25
Mosaic 65
Pea Aphid 34
Powdery mildew 65
Red spider 38
Thrips (See control for onion thrips) 33

TOMATO
Beet leafhopper 6
Blossom end rot 65
Curly top 57
Cutworms 19
Damping off 57
Grasshoppers 25
Tomato psyllid 45
Tomato worm 46
Western potato flea beetle 47

TULIP
Breaking 66
Wildfire 66

TURNIP, See cabbage

VEGETABLES
Ants 4
Beet leafhopper 6
Blister beetles 9
Curly top 57
Cutworms 19
Damping off 57
False chinch bug 21
Garden slug 24
Leather jackets 29
Mormon cricket 31
Red spider 38
Webworms 7
White grubs 47
Wireworms 48

VIRGINIA CREEPER
Leaf cutter bees 29
Red spider 38
Virginia creeper leafhopper 46

WATERMELON
Cutworms 19
Wilt 66

WETTABLE SULPHURS 76

WHEAT
Alfalfa looper 3
Bunt 66
Cutworms 19
Ergot 58
False chinch bug 21
False wireworms 22
Grasshoppers 25
Leaf rust 59
Loose smut 66
Snow scald 67
Stem rust 59
Stripe rust 59
White lined sphynx 48
Wireworms 48

WHITEWASH 77

WILLOW
Oyster-shell scale 34
San Jose scale 40
Tree hoppers 46